Concrete

Vol. 31 Chicago, July, 1927 No. 1

# *Relation Between the* Characteristics of Portland Cement *and* Deterioration of Concrete

### A Discussion of Some of the Characteristics of Portland Cement and Concrete for the Purpose of Arriving at a Clearer Understanding of Why Some Concrete Remains Good and Why Some Disintegrates—Some Suggestions for Improving the Durability of Concrete

By JOHN R. BAYLIS
Filtration Engineer, Bureau of Engineering, City of Chicago, Ill.

## Part I—Characteristics of Portland Cement

CONCRETE is, when properly manufactured and used under conditions for which it is suited, the best building material we have, yet not as much is known about its characteristics as some of the other extensively used materials. This is due to the complex nature of the various chemical compounds entering into the composition of portland cement.

The purpose of this series of articles is not to discourage the use of concrete, but to call attention to some of its limitations when used under exposed conditions. It is hoped that the information will be of some aid to a clearer understanding of why some concrete remains good and why some disintegrates.

With concrete, the chemical analysis of the cement as now conducted gives very little indication of its quality. Neither does the determination of the time of set, strength, etc., give much indication of its durability under exposed conditions. There is great need for methods of analysis in the concrete industry that give some indication of the suitability of concrete for specific purposes.

IT is good for an industry to have someone point out, in a constructive manner, some of its faults. We are too prone to sit back complacently, lulled into a feeling of superiority by the praises heard on every hand.

THE last improvement in making quality concrete has not yet been made. Concrete still has some faults and it is well for us to recognize them. Once they are recognized and we have the courage to admit them, the first step in overcoming them has been taken.

THIS series of articles is published to consider the behavior of concrete under exposed conditions. That some engineers and investigators will not agree with the author, is to be expected. The articles are frankly aimed at a problem that has always faced the industry but about which little has been published.

Discussion is invited.

The production of portland cement indicates the value of concrete now being manufactured, together with other portions of the structure dependent upon the durability of the concrete, to be over two billion dollars annually. That a large percentage of this concrete meets the service demanded of it, no one doubts, yet there is enough that does not to make us wonder if conditions may not be improved. It is believed that a clearer understanding of the limitations of concrete will do more to insure the manufacture of durable concrete than will anything else. No one uses iron or wood for durable structures without protecting them in some way.

Nearly all concrete failures are attributed to poor workmanship or to the use of inferior aggregate. It is true that this is the cause for much of the concrete which is disintegrating, but there are many cases where we are forced to admit that other factors at least have an influence. Failures due to poor concrete that has been made with poor aggregate, by the use of too much mixing water, or to improper methods of handling, will not be considered in the present article, for such factors have been discussed quite fully in the literature on concrete. It is deterioration due to chemical changes in the cement compounds and factors aiding these changes that will be given chief consideration. Porosity is not a chemical change, but it has great influence on the rate at which chemical changes may take place within the interior of the concrete.

### Composition of Portland Cement Not Definitely Known

Bogue[1] gives a very good digest of the various opinions as to the compounds in portland cement. These opinions differ so widely that the layman will probably conclude that the cement chemist knows very little about his product.

For the present article it makes little difference as to who is correct, as long as cement can be produced that will give the desired strength and is durable; that is, it is not the purpose of this article to advocate the production of a new or a special cement, but *to encourage the better handling of a product that is already good.*

### Hydration of the Cement Compounds

No attempt will be made to give the compounds formed in the hydration of cement, for there is not, at present, general agreement as to just what compounds are formed. When reference is made to the high calcium compounds it means compounds that will give up calcium hydroxide to the point of making the water within the pores of concrete over one-half saturated with calcium hydroxide. The compounds are at least of higher calcium content than monocalcium silicate or aluminate.

Solids, as a rule, do not change from one form to another without first going into the soluble stage and then precipitating as the new compound. If this is the case, and it is known to be for most chemical reactions, it seems probable that even though definite compounds of calcium and silica exist in portland cement clinker, it does not necessarily insure the presence of these compounds in the hydrated form after the cement has set.

The writer has been criticized by Bogue[2] for stating that definite high calcium compounds of silica may not exist in concrete and that adsorption by the lower calcium compounds may account for the excess of lime over some hypothetical combination. There is no objection to anyone believing that definite compounds are formed, but the writer still believes that adsorption plays an important part.

It seems likely that more durable products are formed where there is adsorption. If monocalcium silicate, which gives off only a small amount of calcium hydroxide when in contact with water, can adsorb calcium hydroxide from a saturated solution of calcium hydroxide to the extent that the surface of the monocalcium silicate is covered with a layer of calcium hydroxide, then it acts as though this was its equilibrium in water. If adsorption plays no part in the retention of the calcium in the cement particles, it is doubtful if concrete would be a suitable material for some conditions where it is now being used.

One authority has been positive in a verbal statement to the writer that there is gradual hydrolysis of the high calcium compounds of silica when submerged in water, and that these compounds give off calcium hydroxide in excess of the saturation point. Unless he is assuming the rate of hydrolysis to be so slow that it is of little consequence, the writer does not agree with him. If it were true that more than a very small per cent hydrolyzed, we had better stop using concrete for building important structures which are to be permanently submerged.

Assume for the sake of argument that hydrated tricalcium silicate is formed in the hydration of cement and that it will give off calcium hydroxide to the saturation point with the formation of some lower calcium compound of silica. Then assume that the lower compound is monocalcium silicate. The equilibrium for monocalcium silicate is a solution less than one-tenth saturated with calcium hydroxide, whereas the equilibrium for the tricalcium silicate is at or near the saturation point of calcium hydroxide. The rate at which the hydrated tricalcium silicate, or whatever be the composition of the high calcium silicate present, breaks down will depend largely on the concentration of the surrounding solution. If, as soon as the high calcium silicate breaks down to a silicate of lower calcium content and calcium hydroxide, it adsorbs calcium hydroxide in proportion to the concentration present above the equilibrium of the lower calcium silicate, then it seems possible that the transfer of calcium from the interior of the cement particles to the outside of the particles may be materially slowed up by the adsorption.

So far as is known to the writer, all brands of portland cement on the market will, when the cement comes in contact with water, give up calcium hydroxide in excess of the saturation point in the early stages of hydration. This is assuming the ratio of water to cement to be somewhere near that used in the manufacture of concrete.

Some are of the opinion that calcium hydroxide crystals are formed and that this is responsible for a large part of the strength developed by the cement. The presence of a few crystals of this compound in most of the concrete tends to prove that the crystals really are formed. Whether the supersaturation that produces the crystals is due to the hydration of certain compounds, to the presence of compounds like sodium or potassium, or to a tendency for certain hydrated cement compounds to break down by hydrolysis with the formation of calcium hydroxide crystals and some compound of lower calcium content, the writer does not know, for there is some evidence to support any of these assumptions. Perhaps all three play a part.

For crystals to form, the water must be supersaturated with the crystallizing compounds at the time they are precipitating. This is a fundamental law of chemistry which no one doubts. It is nothing uncommon for compounds like calcined calcium sulfate (plaster of paris) to produce a supersaturation of over 100 per cent of gypsum when water is added. This great supersaturation is reduced rapidly, but it is a fact that it exists for a few minutes after the water is added.

The rate at which crystals form will depend to a great extent on the supersaturation of the compound in the water. It is likely that in the rapid hydration of the high calcium compounds in cement there is produced a concentration of compounds in solution that greatly exceeds the saturation point of calcium hydroxide as well as certain other compounds. In other words, there may be compounds precipitating which can be produced only in a solution supersaturated with calcium hydroxide. It is difficult to see how there can be hydrolysis of a compound after the cement has set to the extent of producing calcium hydroxide crystals if this is not the case.

Within 10 minutes to 2 hours after water is added to cement there is almost invariably produced a concentration of soluble calcium hydroxide considerably in excess of the saturation point of this compound. Now if both calcium hydroxide and some other high-calcium compound are being precipitated at the same time, there may be factors, seemingly insignificant, that will vary the ratio of the precipitates quite materially.

---

[1] Bogue, R. H. The Constitution of Portland Cement Clinker, "Concrete," Vol. 29, Nos. 1 to 6, 1926, Vol. 30, Nos. 1 and 2, 1927.

[2] Baylis, J. R. Corrosion of Concrete. Discussion by Bogue. Proc. Am. Soc. Civ. Engrs., Vol. 52, page 1270, August, 1926.

It may be that the most durable qualities of concrete depend on the production of one of these compounds in large quantities. Investigations along these lines may bring forth information of great value. There are a few who believe that the hydrated compounds produced when a decided excess of mixing water is used are different from the compounds produced when the optimum amount is used. It is probable that the amount of mixing water does vary the proportion of certain compounds produced in the hydration of the cement, especially as very soluble compounds occur in small quantities in most cement and may have an influence in proportion to their concentration in the solution.

### Certain Soluble Compounds in Cement May Affect the Quality of the Concrete

Knowing that it is the tendency for part of the hydrated cement compounds to give up calcium hydroxide to nearly the saturation point, what is going to be the effect when sodium and potassium are present in considerable quantities? Table I shows that sodium and potassium hydroxide may be present in solution in some cements to the extent of materially reducing the amount of calcium hydroxide that will exist in the solution.

TABLE I

*Alkali Concentration of Water in Contact with Cement*

Two hundred grams of neat cement were placed in a flask containing 250 cc. of distilled water. The flask was stoppered tightly and agitated frequently to prevent lumping.

| Brand of Cement | Days After Adding Water | Cc. of N/50 $H_2SO_4$ Necessary to Neutralize 10 cc. of the Solution | Percentage of $Na_2O$ and $K_2O$ in the Cement | Parts per Million of CaO in Solution |
|---|---|---|---|---|
| No. 1 | 5 | 111.3 | 1.39 | Less than 100 |
| No. 2 | 5 | 86.5 | .90 | About 300 |
| No. 3 | 5 | 47.0 | .59 | About 800 |
| No. 4 | 5 | 38.5 | .05 | 1,036 |

It is not intended that this be construed as being typical of these brands of cement, but for the samples tested. It is likely that the sodium and potassium vary quite widely in cement from the same mill. On account of the small amount of solution used it was not possible to determine the CaO accurately when the concentration was low, but the figures given are only slightly in error.

Now, if some compound has entered into the solution to the extent of reducing the saturation equilibrium of calcium hydroxide to less than 100 parts per million when it normally should be over 1,500 parts, might not this greatly affect the precipitating compounds?

It is thought that the concentration of soluble compounds in the water within the pores of concrete during the process of setting is of greater importance than is generally believed. Should the reaction be producing one kind of precipitate only, then the concentration of soluble salts within the limits likely to be found in portland cement may not have much influence. But when two or more compounds are precipitating at the same time, which seems to be the case, a small variation in the equilibrium may materially influence the proportion of the different compounds produced. There is no proof at present that such things do happen, but it is worthy of investigation.

A manufacturer having certain raw materials, finds, by mixing them in certain proportions, by heating to a certain temperature, by adding a certain amount of gypsum, and by grinding to a certain fineness, that cement of a certain quality is produced. In this case certain compounds are largely responsible for the binding powers of the cement. Another manufacturer with slightly different raw materials finds that his treatment has to be somewhat different to meet the prescribed standard of strength. It may be that instead of the cement producing the same compounds in the same proportion when hydrating as the first cement, the proportions are somewhat different. Now it may be that the desirable constituents for producing durable concrete where it is exposed vary widely in the two cements. It is believed that much of value can be learned by studying these possibilities.

## Road Builders Making Plans for 1928

The 1928 Convention and Road Show of the American Road Builders' Association will be held in Cleveland, Ohio, January 9th to 13th.

After carefully considering invitations from several cities, it has finally been decided that the next convention of the Road Builders' should be held in Cleveland on account of the many facilities that that city affords and which will permit of a larger and more interesting exhibit.

The exposition will be held in Cleveland's Auditorium and Annex, where every facility for a successful exhibition is to be found. There is available 45 per cent more area than was used in Chicago, with facilities such as railroad tracks immediately adjacent to the exhibition building. With less expense to the exhibitor, a more satisfactory exhibit may be made and more space secured than in previous years. This lack of space during the past few years has been a severe drawback to the many exhibitors who have desired to show improved machines and materials that they were not able to exhibit in Chicago because of the restricted space.

An excellent arrangement has been made with the Convention Board of the Cleveland Chamber of Commerce, by which all hotel reservations will be made through a central bureau, thus assuring everyone of satisfactory hotel accommodations. Definite and detailed arrangements as to how reservations should be made will be made public later.

The American Road Builders' Association at the present time is organizing a Division of County Officials and one of the features of the 1928 convention will be County Officials Day, when papers and discussions covering the problems of county officials will be presented. The entire day will be given up to the activities of county officials and the officers of the day will be selected from county officials.

Due to the fact that there will be very few legislatures in session during 1928, it has been decided to observe Governors' Day and it is expected that a large number of governors of various states will be in attendance.

## Robert W. Lesley Made A. S. T. M. Honorary Member

At the meeting of the American Society for Testing Materials, held June 22nd at French Lick Springs, Indiana, Robert W. Lesley was made an honorary member of the Society. Mr. Lesley is a past president of the Portland Cement Association and an inventor, author and editor.

# Concrete Specifications on Missouri Stadium

## General Design of the Structure—The Specifications for the Concrete—The Mixing Plant—Effect of Lime on the Concrete

By E. J. McCAUSTLAND
Dean and Director, College of Engineering, University of Missouri

THE University of Missouri at Columbia, Missouri, has finished construction of the first unit of a new stadium, which when completed will have a total seating capacity of 76,000.

The completed plans of the stadium provide for a structure, roughly horseshoe in plan, with 78 rows of seats rising in a continuous ramp from the level of the playing field. The plan contemplates the covering of the upper 40 rows of the two ends of this horseshoe with balconies, but the curve of the horseshoe will have no balcony seats. Entrance to the completed stadium is provided at the level of the thirty-eighth row of seats; this plan greatly facilitating movement of the spectators in the filling and emptying processes. Dressing rooms for the teams are placed at the ends of the horseshoe and only slightly above the level, in convenient location for the players.

The stadium is located in a natural valley with the points of the horseshoe directed nearly south. The ramp of the seats intersects the original surface of the ground at about the elevation of the 38th row, so that much of the first unit is resting upon undisturbed material. The next 40 rows when constructed will be supported entirely on columns and girders, and the space thus available under these rows will be separated by walls into independent units for general recreational purposes, such as handball, boxing, wrestling, fencing, etc. In addition to the dressing rooms for the teams mentioned above, one at the end of each point of the horseshoe, and containing lockers, showers, etc., additional dressing rooms will be provided at this higher level.

### Cost of the Structure

The contract for the first unit was let on December 5, 1925 to H. H. Caruthers, Inc., of Kansas City, Mo., whose bid was approximately $267,000. This bid included everything except plumbing, heating and wiring, and the addition of these items has brought the total cost up to about $313,000. The seating capacity of this first unit is 25,000 and it was completed and opened to service on October 2, 1926. The actual work of construction was begun on December 9, 1925, so that the total time spent on the work was something less than ten months.

### The Specifications for the Concrete

The specifications for the concrete work covered the following requirements:

The brand of portland cement had first to be approved by the architects, and only one brand was permitted to be used throughout the work. The "Current Standard Specifications and Tests for Portland Cement" adopted by the A. S. T. M., Serial Number C9-21, were used, and the R. W. Hunt & Co., appointed as Inspectors. The aggregate had to pass the approval of the architects on the basis of a 50-pound sample of the fine and 100-pound sample of the coarse material. For the fine aggregate not more than 30 per cent was permitted to pass a No. 50 sieve, not less than 85 per cent to pass a No. 4, and all had to pass a

o—O—o

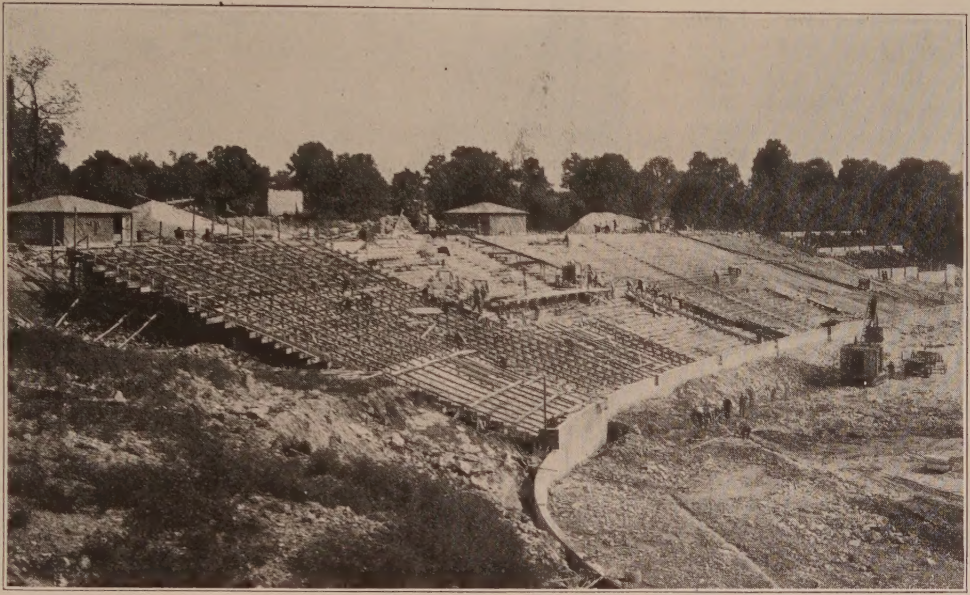
*View of the job as the first concrete was being poured*

o—O—o

⅜-inch sieve. A sedimentation test to determine the presence of silt and clay was included as follows:

"Fill a 32 oz. graduated prescription bottle to the 14 oz. mark with the fine aggregate to be tested; add water to the 28 oz. mark; shake vigorously for one minute and allow to settle for one hour. If more than 1 oz. of sediment appears above the fine aggregate, the material represented in the sample shall be rejected."

The coarse aggregate was permitted to consist either of gravel or crushed stone limestone; the limestone to be of clean, hard stone capable of passing a one-inch ring in any position. Limestone dust in excess of 5 per cent was sufficient to cause rejection. If gravel was used it had to be free from clay, loam, mud balls, lignite and other foreign matter and range in size from one-quarter inch to one inch. For both gravel and limestone not more than 5 per cent was permitted to pass the No. 8 sieve and not more than 15 per cent the No. 4. sieve.



The section about half completed, with form work in place

The proportions were specified as one part portland cement, two parts sand and four parts of coarse aggregate by volume. Slump tests were required during the progress of the work, and the maximum slump permitted was six inches.

In addition to the above specifications, hydrated lime in the proportion of 9 pounds to each sack of cement was incorporated in all concrete mixtures. This was expected to materially increase the workability of the concrete.

### The Excavation

In beginning the work, it became necessary to modify the contours of the site to fit the seating arrangements, and this involved the movement of approximately 85,000 cubic yards of dirt and rock. Some of this material, removed from the sides of the horseshoe was used in building up the curved portion across the valley; but owing to the fact that the excavated material developed greater "swell" than was expected the spoil banks are unusually excessive. The contractor began his work promptly by installing a power line from the city light and power plant to enable him to operate electrically driven power shovels. Later both steam and air-driven shovels were used as well. These shovels worked with a considerable degree of satisfaction even in the rock, which is a comparatively hard limestone, but which was well shattered in the process of blasting. The material was at first removed into auto trucks but these were later replaced by an industrial railway, since the wear on the tires of the trucks was excessive. No special difficulties occurred during the period of construction, although there were some short stretches of very bad weather.

### The Concrete Mixing Plant

When the work had progressed sufficiently to allow the placing of concrete, a crusher was set up at the level of the playing field and a portion of the excavated rock was crushed for use as coarse aggregate. A cableway was installed to transport this aggregate to the level of the 38th row of seats where the mixers were placed. The mixed concrete was conveyed by chutes to place of deposit. This installation was very effective in expediting the work and resulted in a large hourly yardage in spite of the non-massive character of the construction. The work proceeded continuously over the twenty-four hours on the basis of two twelve-hour shifts.

The character of the concrete was remarkable for its "workability"; there was little tendency for the aggregate to separate from the mortar and the whole mass flowed easily into the forms, filling them completely with a minimum of tamping effort. The removal of the forms showed, in all cases, smooth faces with no indication of honeycombing.

### How Tests Were Made

About the first of April, as soon as concreting was well under way, it was decided to inaugurate a series of tests on the concrete. The Engineering Experiment Station sponsored the tests and Mr. H. A. LaRue was in active charge of the work. The plan outlined contemplated a series of compression tests on specimens made of the "run of mixer" molded in 6 x 12-inch cylinders; tension tests on briquettes of the clear mortar; and compression tests of the mortar alone molded into cylinders 2 inches x 4 inches. This series of specimens and the tests on them were extended over the period of placing concrete, or slightly over three months. All these samples were paralleled by other "run of mixer" samples of concrete and mortar made without the lime admixture, in order to compare the ultimate strengths.

Tests of the specimens were made at the age of 7 days and also at the age of 28 days, the results being indicated in the following tabulation, the figures being determined as follows:

A set of 5 specimens were tested and if no individual result varied more than 15 per cent from an average of the other 4 the average of the 5 was taken for that set. Thirty sets were tested and the tabular figures give the resulting average for all. In no case did the average strength of any set vary more than 20 per cent from the final figures given in the table.

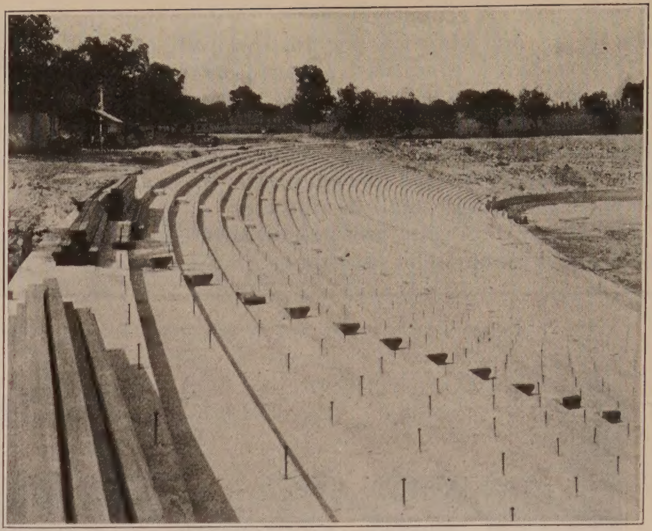
RESULTS OF TESTS ON MORTAR AND CONCRETE USED IN UNIVERSITY OF MISSOURI STADIUM

| | | Lbs. per sq. in. With Lime | Lbs. per sq. in. Without Lime |
|---|---|---|---|
| *Seven-day Tests:* | | | |
| Cylinders 6 inches in diameter and 12 inches long | Compression | 1977 | 1850 |
| Briquettes, mortar | Tension | 383 | 390 |
| Small cylinders, mortar, 2 inches in diam. and 4 in. long | Compression | 2784 | 2636 |
| *Twenty-eight-day Tests:* | | | |
| Cylinders 6 inches in diameter and 12 inches long | Compression | 3175 | 2994 |
| Briquettes, mortar | Tension | 471 | 475 |
| Small cylinders, mortar, 2 inches in diam. and 4 in. long | Compression | 4032 | 3917 |

The concrete with lime admixture seemed to develop about 6 per cent increase in compression strength but apparently there was little effect on the tensile strength.

### Permeability Tests

Tests were also carried out in an attempt to determine the permeability of the concrete both with and without lime admixture. The tests were made by preparing discs 2 inches thick and 6 inches in diameter molded in a 6-inch diameter ring. This ring with the enclosed mortar was clamped between two flanges, one of which had a large opening and the other a small opening for a ¾-inch pipe connection. Water under pressure was conveyed through this pipe to the top of the disc and by means of a gauge was held at 20 pounds pressure. No flow of water through the concrete resulted; a slight moisture on the under side of the concrete was indicated, but did not result in any material drop of the pressure. Furthermore, no difference was observed in the results obtained on the lime samples as compared with those having no lime admixture; possibly due to the richness of the concrete in cement content.



*View showing concrete work of the finished section*

### Conclusion

These tests have indicated the concrete specifications used to be safe and economical, and they will probably be followed in the construction of the section of the stadium yet to be built.

The plans for this stadium were made by James P. Jamieson and George Spearl, Architects, Arcade Building, St. Louis, Mo. Mr. M. F. Marks, Structural Engineer for W. J. Knight and Company of St. Louis, was responsible for the engineering design and superintendence of construction.

## Elasticity of Gypsum Mixes Tested

In "poured-in-place" construction work, where calcined gypsum is used as the cementitious material, it is common practice to mix from 12 to 15 per cent by weight of wood filler with the gypsum. A number of measurements have recently been made at the bureau to determine the effect of the amount of type of filler on the moduli of rupture and elasticity of "first-settle" and "second-settle" gypsum. The scope of the work was not sufficiently broad to be all inclusive, but it is felt that the results obtained are of interest in indicating the magnitude of these values with the mixes employed.

Four brands each of "first-settle" and "second-settle" gypsum and two kinds of wood filler, one a shredded cottonwood fiber, the other wood chips, were obtained as representative of the industry. Three specimens were made of each neat gypsum and three specimens of each gypsum when the filler content was varied by 1 per cent increments, from 12 to 15 per cent by weight of the dry mix. The mixes were cast in wooden molds, so as to produce specimens 3 by 3 by 30 inches. With the neat mortars the testing consistency of the American Society for Testing Materials[1] was used. When the wood fiber or chips were added it was found impracticable to use this consistency, so the mixes were made so as to pour readily. The specimens were dried in the laboratory for 14 days before testing.

The following table is a summary of the results obtained:

EFFECT OF AMOUNT AND TYPE OF FILLER ON MODULUS OF ELASTICITY AND MODULUS OF RUPTURE OF GYPSUM

| | Modulus of Elasticity (Lbs./In.$^2$) — Wood Fiber (Percentage of Filler) | | | | | Wood Chips (Percentage of Filler) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Kind of Gypsum | 0 | 12 | 13 | 14 | 15 | 12 | 13 | 14 | 15 |
| First-settle calcined gypsum | 409,000 | 199,000 | 158,000 | 113,000 | 79,000 | 192,000 | 158,000 | 129,000 | 92,000 |
| Second-settle calcined gypsum | 511,000 | 201,000 | 157,000 | 139,000 | 108,000 | 213,000 | 153,000 | 139,000 | 112,000 |
| | Modulus of Rupture (Lbs./In.$^2$) | | | | | | | | |
| First-settle calcined gypsum | 324 | 142 | 112 | 71 | 59 | 158 | 117 | 83 | 65 |
| Second-settle calcined gypsum | 299 | 167 | 144 | 109 | 86 | 156 | 116 | 97 | 77 |

---

[1] Standard methods of testing gypsum and gypsum products, Serial Designation C26-23, A. S. T. M. Standards, p. 775; 1924.

# New Fire Tests on Concrete Tile

## Abstract of a Report on Fire Tests Made on 8-Inch and 12-Inch Stone-Tile Bearing Walls at the Underwriters' Laboratories

A RECENT report by the Underwriters' Laboratories on fire tests of 8- and 12-inch "Stone-Tile" walls has contributed valuable additional data to knowledge of the fire resistive properties of hollow concrete building units.

The units used in the construction of the Stone-Tile test panels are two-cored units, having webs and shells uniformly 1¾ inches thick (nominal), and exterior dimensions of 3½ x 7¾ x 12 inches. They are thus considerably smaller than the block concerned in an earlier investigation.

Coarse aggregates of two widely different types were represented in the Stone-Tile test specimens. One was a screened pebble aggregate whose silica content considerably exceeded the maximum percentage allowable under existing standards. The other was a crushed slag of low silica content. The average crushing strength of the silicious aggregate specimens was 1524 pounds per square inch of the gross cross-sectional area; and of the slag specimens, 996 pounds per square inch. The absorption was respectively 3.7 and 7.5 per cent.

### Scope of Tests

The Stone-Tile investigation included both 12-inch and 8-inch walls, whereas a former program was confined to 8-inch walls.

It is also of interest to note that the Stone-Tile tests are the first to be conducted under the revised specifications which require:

(1) Application of rated load to all test panels while undergoing fire endurance or fire and hose stream tests.

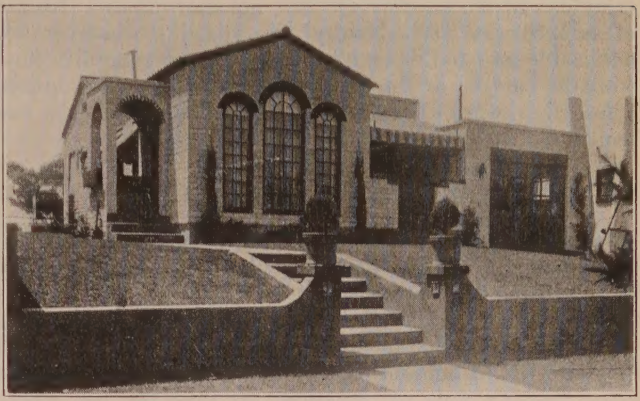
(2) Application of double the rated load after panels have undergone fire and hose stream tests, to determine whether collapse has been imminent under the normal load.

Three full-sized panels of Stone-Tile were employed, two being 8 inches in thickness and the third being 12 inches. One size of unit, namely, the 3½ x 7¾ x 12-inch, was used for all three panels. In the 12-inch panel they were laid crosswise to the wall, and in the 8-inch panel were, of course, laid lengthwise. Joints were broken in the usual manner, half units being used at one end of each course.

The upper three-quarters of each panel was composed of units manufactured from the silicious pebble aggregate. These were shipped from three different plants in the vicinity of Los Angeles, California. The lower one-quarter was composed of units manufactured from the slag aggregate. They came from Atlanta, Georgia.

The panels were built upon a heavy steel loading beam which was protected from the fire by brick. A battery of hydraulic jacks placed under this beam was the means of applying pressure to the panel during the tests, the pressure being regulated by a gauge and valve situated remote from the furnace.

The units were laid in portland cement mortar composed of three parts of good lake sand to one of portland cement (by volume) and hydrated lime not exceeding 15 per cent of the volume of cement.



*A fire resistant house made from the type of concrete units tested*

### Fire Endurance Tests—8-Inch Panel

The panel remained in the furnace 3 hours and 15 minutes, by which time the critical temperature had been reached on the unexposed face. Throughout the test the combined live and dead load was maintained at 80 pounds per square inch of gross cross-sectional bearing area. This was in accordance with the working stress for hollow concrete units recommended by the Building Code Committee of the Department of Commerce.

Cracks commenced to appear in the unexposed face soon after the start of the fire, faint and irregular at first but developing later into two general vertical cracks of which one attained a maximum width of 3/32-inch and the other 3/16-inch. A number of smaller cracks were also noted but there was no marked horizontal cracking.

Throughout the furnace exposure, no luminosity was visible through any of the cracks, with the exception of a single point of light at 140 minutes through an opening about 1/16 of an inch square at one of the cracks.

The maximum deflection was ¾-inch toward the fire and was recorded at the center of the panel at one hour and 30 minutes.

No marked cracking was apparent on the exposed face during the test and no bulging was noted. It was impossible to observe any marked change in the color of the sample during the test. After the removal of the panel from the furnace and during its subsequent cooling, fine vertical hair cracks opened up and the exposed face shells seemed to have been dehydrated to a depth of ½ to ¾ inch from the fire side, which was comparatively soft. The mortar in the mortar joints seemed more affected by fire than the exposed surfaces of the units. On the unexposed side neither the mortar nor the faces of the units seemed appreciably weakened.

The load was held on the panel for one hour and 15 minutes of the cooling period after which it was released in 5 minutes without any noticeable effects or deflection, and after releasing the load the panel appeared to be in a good, stable condition.

### Fire and Hose Stream Test—8-Inch Panel

The second of the two 8-inch panels was subjected to Standard Fire and Hose Stream Test, loaded as before to

80 pounds per square inch of the gross cross-sectional area. It was exposed to standard fire for one hour, then withdrawn and exposed while fully loaded to standard water stream applied for 2 minutes, 34 seconds, to the incandescent exposed face of the panel.

The action of the hose stream appeared to have very little effect on the exposed face. No cracks could be detected and in general there was very little erosion of the surfaces of the units, except for occasional individual samples. In the most severe case not more than 1/16-inch of surface was washed away. No spalling whatever was noticeable and the mortar joints remained generally flush with the surface of the Stone-Tile, except at a few points where they were eroded about 1/8-inch deep after a few hours.

### Excess Load Test—8-Inch Panel

In accordance with the standard specifications for Excess Load Test it was necessary that the panel that had been subjected to fire and water stream should successfully withstand after cooling, a total load equal to its dead load plus twice its superimposed live load, which in this case would amount to 153 pounds per square inch of gross bearing area or, roughly, 70 tons for the whole panel. This load was applied gradually by the hydraulic jacks in 5 minutes, then held constant for 5 minutes, and finally gradually released in 5 minutes.

The general appearance of the exposed surface after this test revealed neither large nor small cracks. No change could be detected in the appearance of either the exposed or unexposed faces as compared with their appearance after the hose stream. No new cracks developed in the unexposed face.

A slight permanent shortening of about 1/8-inch took place. Deflection measurements indicated a maximum bowing toward the unexposed face of from 1/4-inch to 3/8-inch, which decreased to 1/8-inch after the load was released.

### Examination of Stone-Tile Units After Tests of 8-Inch Panels

The units from both of the 8-inch panels were carefully examined when the panels were dismantled.

Practically all of them, except those which occupied a position intersecting the main wall cracks, could be pried loose from the mortar and removed to the inspection bench without breaking; although nearly all were found to be cracked to a greater or lesser extent, when examined under a strong light—and they had been obviously weakened by the previous exposures.

Perhaps the most interesting disclosure lay in the fact that 95 per cent of the cracks were in the face shells; whereas in the former tests of 8x8x16 units the cracks were generally in the cross webs, which tended to weaken or break the tie between the inner and outer faces of the wall.

Units subjected to Fire Endurance Test retained from 79 to 85 per cent of their original strength, while those subjected to the Fire and Hose Stream and Excess Load Tests retained from 85 to 97 per cent of their original strength.

No evidence of spalling of either the interior or exterior surfaces was found.

### Investigation of 12-Inch Stone-Tile Wall

In the investigation of the 12-inch Stone-Tile wall, one panel was subjected to all of the tests that would be required of two panels under one of the optional programs in the Standard Specifications. This meant that a fully loaded panel must withstand the entire Fire Endurance period before applying the hose stream and that it must withstand the excess load test in addition to the Fire Endurance and Hose Stream Tests.

The 12-inch Stone-Tile panel remained in the furnace 7 hours and 20 minutes, before the maximum limiting surface temperature was reached at the hottest thermocouple on the unexposed face. The average of all stations at this time was as low as 235 degrees F.

No through openings or flame passage developed during any part of the test. At 6 hours and 20 minutes luminous material could be seen through a 1/8-inch length of a crack in one of the mortar joints. A tuft of cotton placed at this point, however, did not discolor during the remainder of the fire exposure or subsequent cooling.

The maximum deflection toward the fire at any time was 3/4-inch.

No marked cracking or spalling of the exposed face was apparent at any time and no bulging was noted. At 5½ hours no apparent change had taken place in the character of the surface except that it had become steadily brighter and more luminous as the test progressed.

The panel appeared to be quite stable under its load, during the entire Fire Endurance Test. This was evidenced by the steady and consistent indications of the expansion gauges, the ease with which the pressure on the hydraulic jacks was maintained uniform, the gradual formation of cracks, and the slight bowing of the panel of 3/4-inch toward the fire.

### Hose Stream Test of 12-Inch Panel

The water stream was applied to the 12-inch Stone-Tile panel 15 seconds after its withdrawal from the furnace following its 7 hours and 20 minutes of exposure to standard fire. The exposed surface was uniformly and highly incandescent at this time and seemed to be in a partially fused condition. No through openings, cracks or other easily discernible irregularities were observed in any of the various sections.

After 5½ minutes of uniform water application at 45-pound pressure it was seen that no spalling or erosion of the panel had occurred in the upper three-fourths of the panel, but considerable erosion and possibly some spalling of the exposed faces of the slag aggregate units was observed. About 60 per cent of the slag units were so affected.

No fluctuation in hydraulic pressure in the loading jacks occurred during the relatively sudden cooling of the exposed face with the water stream. This may be taken as indicative of the general stability of the panel under exceedingly severe conditions, while carrying a uniformly applied load of 80 pounds per square inch.

No new cracks appeared in the unexposed face during application of the hose stream, or in subsequent cooling, and no through openings of any kind, either for passage of fire or water streams, could be found.

After two hours of the cooling period, surface temperatures reached a maximum of 510 degrees F. and showed a tendency to decrease at about 2½ hours. A maximum permanent deflection of 3/16-inch toward the fire side was recorded.

### Excess Load Test of 12-Inch Panel

The load applied to the 12-inch Stone-Tile panel in the Excess Load Test amounted to approximately 109 tons for the 1428 square inches of gross sectional area, or 153 pounds per square inch. This test was made after the panel had cooled, following the Fire Endurance and Hose

Stream Tests.

When the load reached 128 pounds it was apparent that the wall had sheared into two sections near the center line, leaving in effect a 7-inch wall of single-cored units to bear the brunt of the load. The exposed end shells of many of the slag units were seen to drop off during this period, and the unexposed face showed a slight bulging of ½-inch away from the fire side. By the time the load had reached the desired 109 tons the exposed surface of the upper three-fourths of the panel showed a very decided bulging away from the body of the panel, accompanied by considerable dropping of portions of broken units from the interior of the panel. The bulged surface itself, however, was like a flexible or rubbery blanket due to partial fusion which had occurred, and it remained in place.

*Appearance need not be sacrificed to attain fire safety. This house is built of stone-tile*

Summarizing these occurrences it may be said that about 5 inches of wall thickness measured from the exposed face had been eliminated as a load-bearing portion of the wall. The remaining 7 inches therefore sustained its own dead load and double the rated live load for the original 12-inch wall. The load sustained was therefore in the vicinity of 250 pounds per square inch of the remaining cross section area or well above three times the normal rated working stress.

While sustaining this load, the 7-inch wall showed indications of approaching failure due to excessive and permanent deflection probably caused by crushing of the mortar joints nearer the exposed face.

Upon dismantling the panels, the 7-inch single-cored units remaining were found to be in good, hard condition. In fact, their compressive strength based on net area was substantially greater than before the fire. Based on gross area of a full unit, the strength was from 62 to 79 per cent of the original strength before the fire test even though the units had only 60 per cent of their original gross bearing area. This was the case in all sections of the wall.

Following is the summarized rating for Stone-Tile walls as given in the report of the Underwriters' Laboratories:

"The tests and examinations reported herein show:

"(1) That Stone-Tile hollow units, nominally 4 by 8 by 12 inches, made in accordance with the specifications contained in this report regarding materials, proportions, and methods of manufacture, when assembled into walls 8 inches thick, and with the usual limitations as to height and unbraced area, may be classified as 3-hour load-bearing walls.

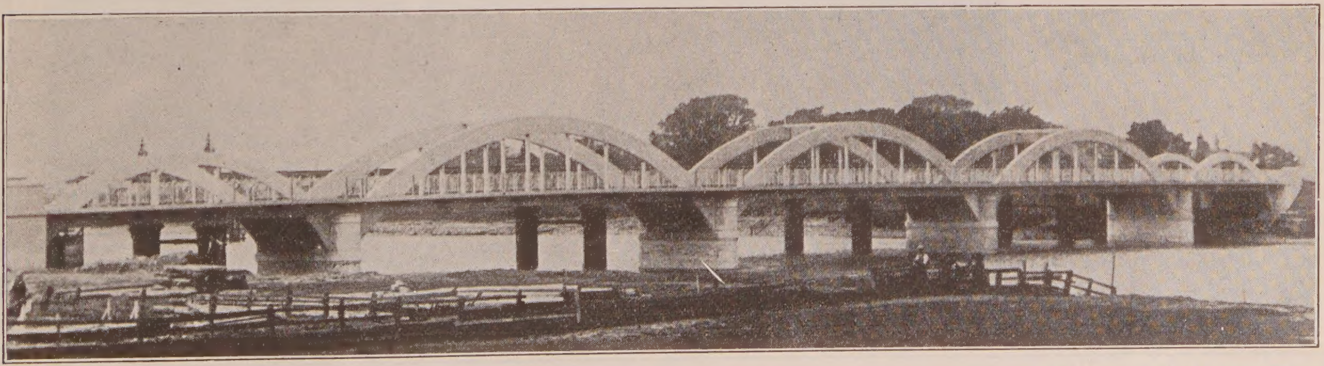
"(2) That Stone-Tile hollow units, as described above, when assembled into walls 12 inches thick and with the usual limitations as to height and unbraced area, may be classified as load-bearing walls of at least 4½-hour fire endurance. Although the actual duration of the Fire Endurance Test on the test wall was 7 hours and 20 minutes, its seriously impaired condition at the end of the test, the practical certainty that some portion of the cracking away of the hotter third occurred earlier in the test, and the precedent regarding conservative classification of brick walls already established, appear to indicate 4½ hours as a reasonable minimum classification."

## A. G. C. Chapter Insures Attendance

Highest possible attendance is secured by the Missiouri Chapter of the Associated General Contractors of America by holding the meeting on the evening prior to the day on which highway lettings are held.

## England Opens Largest Concrete Ferro Bridge

England has thrown open to traffic a new ferro-concrete bridge, the largest in that country. The structure is a skeleton arch structure from which the roadway is suspended. This bridge is at Kings Lyn, over the Ouse.

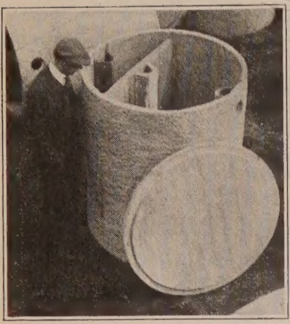


(International Newsreel Photo)

# *How to Make—*

# Concrete Septic Tanks

## Types of Septic Tanks—How They Operate—How to Install Septic Tanks—Manufacturing Methods—Costs—Investment Required—Merchandising Methods—Profits



THERE is much of similarity in the manufacture of concrete septic tanks and concrete burial vaults. Concrete septic tanks as a specialty for the products manufacturer, offer fair profits if intelligently merchandised in a locality that offers a market for this type of concrete product.

Profits in concrete septic tanks run from about $10 to $50 per unit, depending primarily on local conditions. If quality tanks are manufactured and aggressive sales policies are inaugurated, the concrete septic tank will make a desirable specialty for the products manufacturer located in a favorable community.

### What is a Septic Tank?

A septic tank is not a cesspool. A cesspool is unsanitary and dangerous. A septic tank is scientific, sanitary and safe.

The septic tank method of disposing of household and human wastes is the most satisfactory known where a municipal sewerage system is not available. Well made concrete is an ideal material for septic tank manufacture because of its permanence, density, strength and its ability to resist corrosive action. Competing material interests often attempt to discredit the use of concrete for this purpose, but such claims are not founded on fact. Everywhere engineers are endorsing well made concrete as resistant to sewerage.

### How a Septic Tank Operates

A septic tank is a darkened, water-tight and almost air-tight receptacle whose function is to separate and break up the solid matter in sewage. It is placed underground and is so designed that the sewage passes through it very slowly.

In operation, the solids settle at the bottom of the tank. This matter is called "sludge." The material floating on the surface of the liquids is called the "scum" or "mat."

The solids setting at the bottom of the tank are worked on by organisms called "anaerobic bacteria," which convert the solids into gases and liquids. Approximately twenty-four hours are required to break up the solid matter and the tank should permit sewage to remain at least that long. For this reason it is absolutely necessary that the first settling chamber be large enough to prevent agitation when sewage enters the tank.

With a tank that is operating satisfactorily, the liquid called "effluent" is practically clear as it flows out of the tank. Although it is clear, it is far from being pure and must be further treated in the absorption system which will be described when the installation of the tank is discussed.

### Types of Septic Tanks

Septic tank designs vary in detail but are the same in principle. For instance, there are the deep cylindrical type and the shallower rectangular kind.

The single chamber type with baffle boards is the simplest type. Good practice dictates that every tank be so designed that a depth of not less than four feet of liquid be maintained. Any increase in capacity can be secured by either deepening the tank or extending the length.

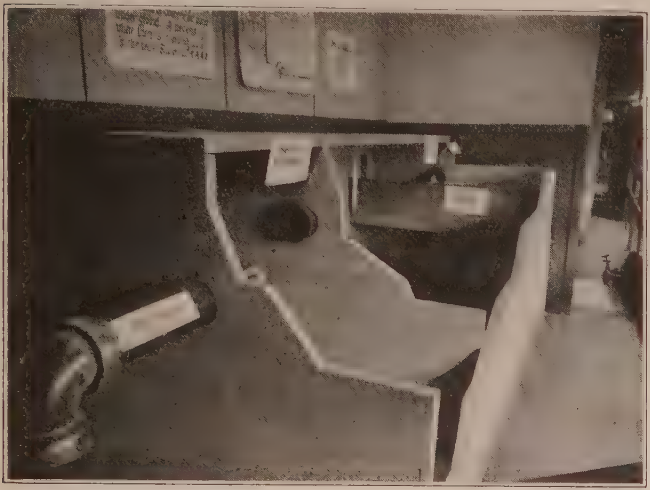
o—O—o

*A typical batch of tanks ready for shipment*

o—O—o

Some authorities on sewage disposal recommend the use of a tank with two settling chambers in preference to the single chamber type, believing that an additional chamber provides for more complete decomposition of the sewage. Sometimes two or three single chamber tanks are installed together in a system to secure greater capacity and more efficient handling of sewage.

Local and state laws often dictate the design and size of septic tanks that may be installed. It is well for the prospective manufacturer to acquaint himself thoroughly with these regulations so that his product will meet with the full approval of the health authorities.



*A septic tank of the box type cut away to show interior construction*

### Septic Tank Sizes

A good general rule to follow is to allow at least 50 gallons capacity for each person served in selecting the size of the tank to be installed. It is better to allow for a greater capacity than for "just enough." Detailed recommendations vary, but the following table will indicate the capacities required for serving varying numbers of persons.

| | —Inside Dimensions— | | | |
|---|---|---|---|---|
| Number of Persons Served | Length in feet | Width in feet | Depth in feet | Gallons Capacity |
| 7 or less | 6 | 3 | 5 | 500 |
| 10 | 7 | 3 | 5 | 650 |
| 14 | 8 | 3 | 5 | 750 |
| 21 | 9 | 4 | 5 | 1100 |
| 24 | 10 | 4 | 5 | 1200 |

The dimensions given are for rectangular tanks. If circular tanks are used, they can be installed several in a system to make up the desired capacity. Circular tanks are usually supplied in sizes of 100, 150, 200, 300, and 500 gallons capacity. Larger tanks are usually made on special order.

### Manufacturing Methods

Detailed instructions for setting up and removing the commercial molds sold by reputable manufacturers are always furnished by the makers of the molds. They will vary, of course, with the design of the mold.

Because concrete septic tanks are so much under fire by competitors, it is doubly important that care be exercised to secure a quality product. One satisfactory tank will sell many more and quality concrete is the best insurance of the customer's lasting satisfaction.

Aggregates must be clean and well graded. They should consist of natural sand and pebbles or hard, durable screenings. The material should run from fine to coarse, the longest particles not over ½-inch in size.

Usually a 1 to 3 mix is used. With clean, well graded aggregate, thorough mixing and careful placing, this mix will result in a tank of the necessary strength and density.

It is necessary to mix the concrete fairly wet so that it will fill every part of the mold. Do not use more water than is necessary to get a mix that will place well, because an excess of mixing water weakens the concrete.

It is best to mix the concrete by machine. Mix the cement and aggregates dry until the batch is of a uniform color. Then add water and continue mixing for at least three minutes more. A little longer mixing time makes the concrete more workable and adds to its strength.

Some manufacturers add some admixture for waterproofing the concrete. Various types of these waterproofing materials are available for the manufacturer who wants to add them to his concrete.

Reinforcement will, of course, be placed as recommended by the mold manufacturer. Usually some type of wire fabric, expanded metal or mesh field fencing is used. At points where special strains are applied, this is augmented with round reinforcing bars.

### Placing and Curing the Concrete

When the forms are assembled and the reinforcing is securely in place, the concrete is placed into the forms. The arrangement used for handling the concrete depends on personal preference and plant layout. Usually the wet concrete is carried to the molds for placing.

It is necessary to spade the concrete thoroughly so that every part of the mold will be filled. Care must be taken to work the concrete around and between the strands of the reinforcing.

When the molds are filled, they are allowed to stand for two days, after which the molds are removed. After the forms are removed, they should be carefully cleaned and oiled in preparation for making the next tank. The tanks should be kept wet for at least 6 days and ought not to be delivered for placing until they are 28 days old.

*A group of tanks curing in the open*

### Installing Septic Tanks

Usually the septic tank is installed by the manufacturer. Successful septic tank manufacturers have found this to be the best practice.

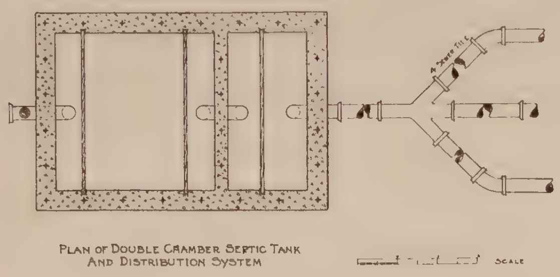
The hole for the tank is dug and prepared by the plumber or by the owner of the house to be served. The septic tank manufacturer places the tank in position and his part of the job is completed. The plumber makes the necessary connections to the plumbing fixtures in the house.

### The Distributing System

Once the septic tank is in place, it is necessary to make provision for purifying the "effluent" referred to earlier in this article. This is as important as the successful functioning of the tank itself.

Various methods of distribution have been used, but one of the most generally satisfactory schemes is the use of a sub-surface line of drain tile. The effluent is discharged into this line from which it is absorbed into the soil. In the soil are countless anaerobic bacteria that act on the sewage and complete the process of purification. An illustration shows the method of installing the tile.

The length of the distributing system tile lines depends on the character of the soil and the amount of sewage to be purified. In light, porous soils, a length of 30 feet of tile line for each person served is sufficient. In tight soils, this is often increased to 100 feet per person.

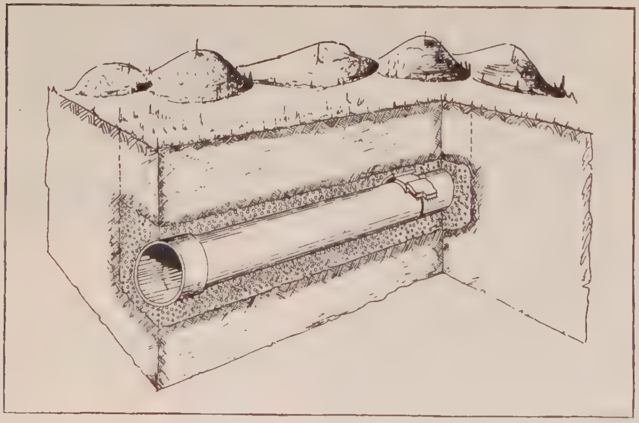


PLAN OF DOUBLE CHAMBER SEPTIC TANK AND DISTRIBUTION SYSTEM

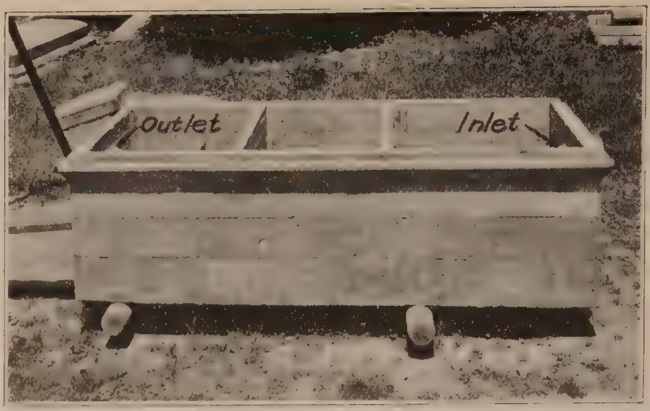
### Merchandising

Just as the undertaker is the logical man through whom to merchandise burial vaults, so the plumber is the man through whom septic tanks can best be merchandised. It is well for the septic tank manufacturer to enlist all the plumbers in his sales area as his aids. By appointing them as agents and paying them a generous commission (varying from 10 per cent to 50 per cent) on the consumer price, the tank manufacturer gains the plumber's good will and his cooperation.

But it is not enough to depend on the plumber to bring in the orders. Every new house built in the sales area that is isolated from a modern sewerage system is a prospect. Every house already built that is not connected with a sewerage system is a prospect. If these are definitely appealed to either by advertising or by personal calls, the market for septic tanks can be considerably stimulated.



*Method of embedding drain tile in gravel which is very effective in tight soil*



*A typical tank of the box type*

Definite sales campaigns in the various smaller towns in the sales area have been entered into by septic tank manufacturers with outstanding success. It is well to gain the endorsement of the mayor and the health officer in each city in your sales area and to use them in your sales efforts. Then get the leading plumbers to back you and follow up with personal calls and advertising. Even a small community can yield a respectable amount of business.

### Investment Required

It is possible to start the manufacture of concrete septic tanks by purchasing say 2 molds—one for making 100 gal. capacity tank, the other for a 300-gal. tank. With these molds various combinations can be made and installed to meet varying demands for capacity.

Such molds will cost in the vicinity of from $300 to $500. These, with a set of chain hoists for installing the tanks (cost about $25.00) will enable the products manufacturer to make a start in his new specialty.

Materials for each tank of average size will cost from $7.00 to $15.00 depending on the location of the plant.

One man can mix the concrete for one tank and place it in the mold in from 6 to 7 hours. Two men can install a tank in about 2 hours. It is possible for a man starting on a small scale in this specialty to make tanks one day, sell or place them the next day and on the following day remove the forms and repeat.

With profit on each unit manufactured and sold running from $10.00 to $50.00, the concrete septic tank is a specialty that well merits the serious consideration of the favorably situated block manufacturer who is considering taking on a specialty.

*Showing method ordinarily used to install septic tanks. Note the one suspended by the block and tackle from the tripod*

# EDITORIALS

## *Quality Control Progress*

SEVERAL articles in this issue feature the use of controlled concrete in various types of reinforced concrete structures. These jobs are typical of hundreds of others now going on in every section of the country. Slowly but surely thinking engineers and contractors are discarding the old haphazard methods of making concrete and adopting the newer, surer methods that guarantee satisfactory results.

The trend of practice now bears more heavily on the practical side of the question of quality control rather than on the theoretical. Jobs everywhere are demonstrating that the methods now in use are practical—that they can be applied to field conditions with results mutually beneficial to the owner and the contractor. The development has been slow, but the first doubts of the practicability of these newer methods have been proven to be groundless and future progress will be accelerated.

It is interesting to note the progress of this movement. For many years the purely arbitrary methods of concrete proportioning held undisputed sway. It was assumed that a balanced mix was one in which the relation of fine to coarse aggregate was approximately 1 to 2. Strength was a factor of the amount of cement used so that naturally a 1:2:4 concrete was stronger than a 1:3:6.

Then came a series of researches aimed at the theory of aggregate grading. Attempts were made to obtain concrete of greater density. But all this time the water content in the mix was completely ignored.

Soon it was learned, however, that regardless of the proportions used, a definite relation existed between the strength of the concrete and the ratio of the amount of water to the cement used. This theory was checked and rechecked and finally resulted in the present universally accepted water-cement ratio law.

But in the earlier stages of the application of this law, it was tied up with what was then considered a very complicated system of grading of aggregates called the fineness modulus. This led to some confusion and the newer method of proportioning was for a long time considered impractical for the average job conditions.

But in the last few years emphasis has been placed on the practical and on the newer methods of proportioning. It was found that the water-cement ratio was one thing and the scientific grading of aggregates another thing entirely. The first definitely fixed ***strength*** of the concrete and the second determined ***workability*** and ***yield***. When a certain definite strength was wanted, it was only necessary to specify the amount of water to be used for each sack of cement. The contractor could use any proportions he desired so long as he got a workable mix.

Now we are learning to co-ordinate the two principles of water-cement ratio and scientific proportioning. The contractor is finding that by using the newer method of proportioning he has a greater choice of available aggregates, which means economy in buying. He also finds that by proportioning properly he gets a greater yield of concrete for each sack of cement used and that also means a saving for him. Finally, he learns that certain combinations give him a more workable mix than others and another item in his favor is established.

All these developments are of a practical nature. The contractor can understand them and profit by their application to his job. It is these practical features that are the cause of the present rapid growth of quality control jobs everywhere.

## *Hopeful Signs*

THE consolidation of concrete products machinery manufacturers, reported elsewhere in this issue, carries with it the promise of an enlarged program of engineering research and service which is certain to meet with the favor of the men who use the machinery.

The idea that products machinery should be sold on the basis of performance, and backed up by service that guarantees the predicted output, is not a new one, but it is one which has sometimes needed emphasis. The fact that the new consolidation bids fair to furnish such emphasis is attested by the spirit of its first public announcement, which outlines in a very general way the plans the new corporation is making to establish closer touch with the industry.

It is almost inevitable that the new corporation will follow a sales policy which has in view the general good of the industry, for the size of the corporation is too great to permit it to prosper without the general good will of the field. Such a policy, if logically adhered to, will in turn have its effect for good upon competitive manufacturers by making possible a higher sales standard throughout the industry in place of the destructive competition that sometimes marked the past.

We hope, and incline to believe, that the trend of events points to the gradual elimination of the incompetent products manufacturer—the fellow who has been sold equipment in advance of any information as to its proper use, and who has never seen the industry in its true proportions.

As manufacturers begin to see the error of aggressively promoting the sales of machinery to this type of producers, the parasitical plant will gradually become a thing of the past, for this particular branch of the industry cannot be sustained without the constant recruits that machinery salesmen have been supplying.

# Quality Control on Big Hotel Contract

## Design Based on Quality of Concrete—Built Under Continuous Engineering Inspection—Field Control Methods—Plant Arrangement — Quality Control of Concrete Proves Economical

DURING the construction of the McCormick Hotel, in Chicago, builders and others who are familiar with the principles of making good concrete often commented on the excellent quality of that material in the structural frame and floors of the building. The structure is now very nearly completed.

The McCormick Hotel is a 16-story reinforced concrete building at the southwest corner of Ontario and Rush Streets, 108 by 135 feet in plan, and was built at a cost of about $1,250,000. The nature of the occupancy made it feasible to utilize one of the lighter types of reinforced concrete floor construction, in this case consisting of combination reinforced concrete joist and clay tile construction. The joists are 5 inches wide and in most of the floor panels the tile are 6 inches deep, with 2½ inches of concrete over the tile, making a total structural floor only 8½ inches deep.

The aggregates used in this building were the regular commercial aggregates available in the Chicago market. The coarse material was crushed stone coming from various sources. The sand came from the region around West Chicago and north of that point.

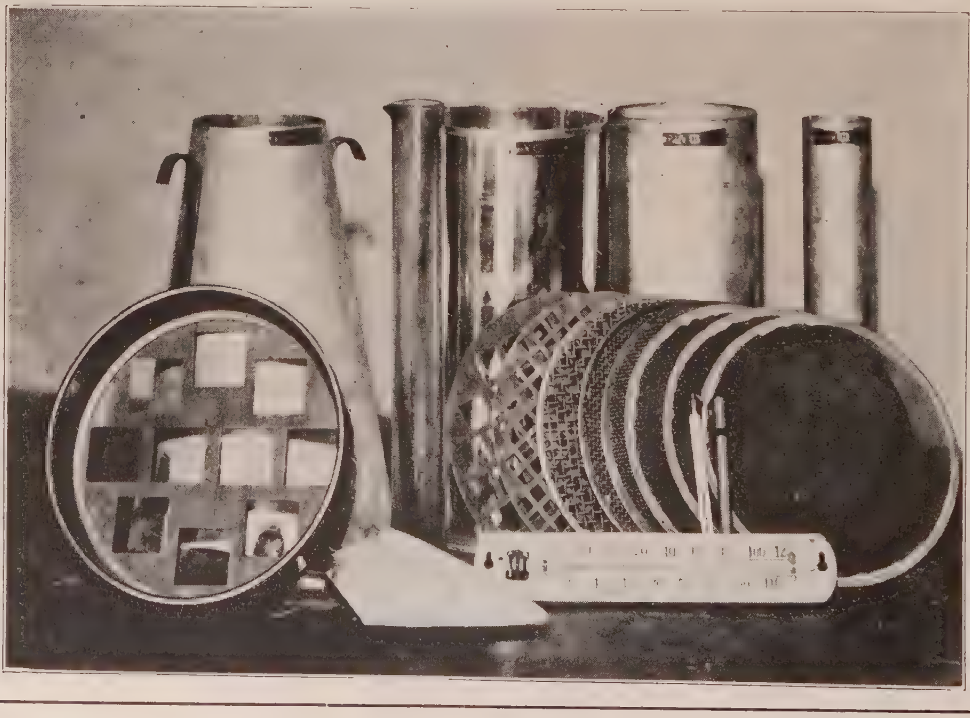
### Inspection

This building is one of the many structures in Chicago which in recent years have been built under expert engineering inspection. This particular work was carried on under the inspection service of the Robert W. Hunt Company, 175 W. Jackson Blvd., Chicago. The work was handled in the department supervised by D. B. Rush. The inspecting company in this instance was employed by the contractor, a provision to this effect having been incorporated in the architect's specification. There is no set practice on this point, since in some cases the inspecting company is employed by the owner, and in still other cases by the banking organization through which the building is financed.

### Design Based on Quality of Concrete

The design of the McCormick Hotel was based on an expected strength of not less than 2,000 pounds a square inch for the concrete in the floors and not less than 3,000 pounds for the concrete in the columns. The approximate proportions of materials were 1:2:4 and 1:1:2 respectively, but the proportions were varied as necessary to produce the desired strength and workability. The water-cement ratio used in the concrete for the columns and the floors was about 6½ gallons and 7½ gallons to the sack of cement, respectively. If soft burned clay tile had been used in the floors, considerably more water would have been used in the concrete for the floor construction, to allow for water absorbed by the tile. However, the architect eliminated this uncertain element by specifying hard burned tile, which absorbed very little water.

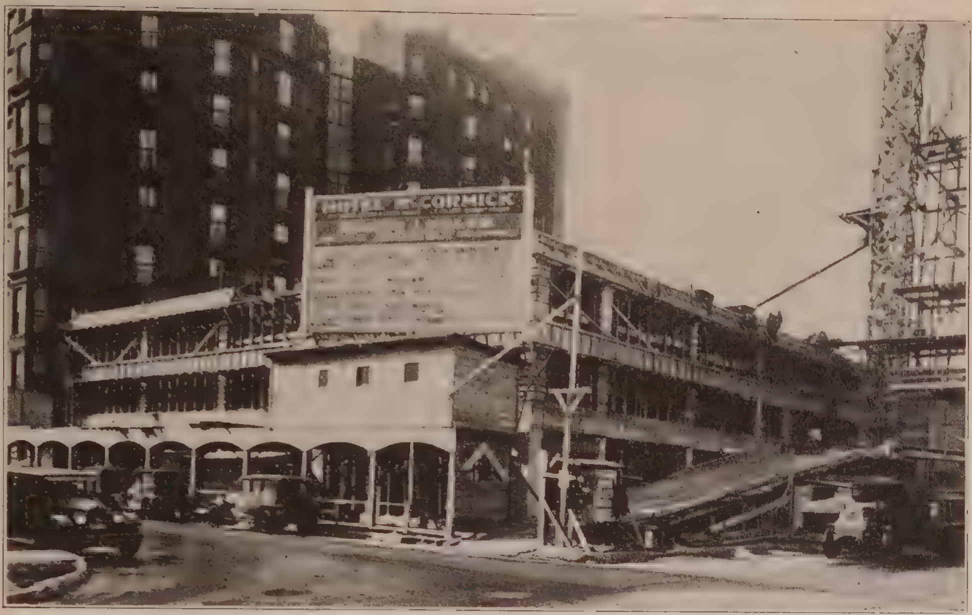
The actual strengths attained averaged somewhat better than the assumed strengths, though a few specimens fell slightly below the minimum specified. In general, the concrete in the floors tested from 2,000 to 2,700 pounds a square inch at the age of 28 days, while the strength of the concrete in the columns ranged from 3,000 to 3,700 at the same age. Some specimens of column concrete tested at later periods indicated strengths as high



*Equipment used by field inspector for testing aggregate and concrete* as 4,400 pounds a square inch at 2 months and 4,900 pounds at 3 months.

## Field Control Methods

The field equipment used by the inspector on the work is of very simple character and light weight. The entire set of equipment used is shown in one of our illustrations. In addition to this equipment, a sand box was built for the storage and curing of test specimens.



*Progress made to October 21, 1926. At the right is the ramp for the delivery of sand and stone to hoppers under the upper end of the ramp.*

The man who actually tests the specimens in the inspecting company's laboratory has no knowledge of the age of the specimen, the proportions used, or of the purpose for which the concrete is intended. He identifies a specimen only by the serial number on a standard card which accompanies it, on which is indicated the nature of the tests to which the specimen is to be subjected and the date on which they are to be made.

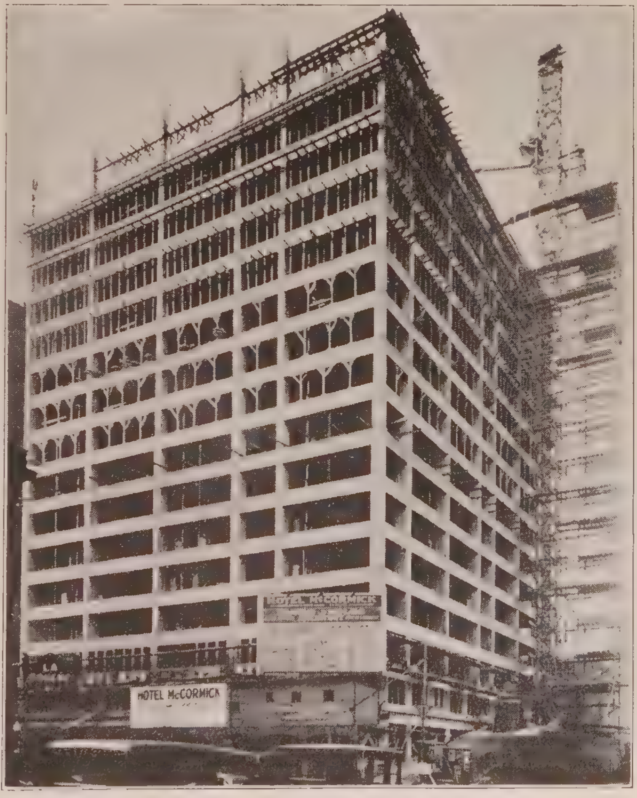
The inspecting company assigned only one man to the actual field inspection of this work. This is the usual practice where the work is concentrated in one place, as with a building. Of course, when work is carried on in double or triple shifts there must be one field inspector for each shift. The inspecting company also employs two supervisors who maintain general supervision over all concrete inspection work under the company's charge in the Chicago region. The supervisors keep in close contact with the field inspectors' work. On a building where both concrete work and structural steel are under this company's inspection service there will be two field inspectors, one looking after the concrete work and the other after the structural steel. The latter work is handled by a separate department in the company's organization.

The work of the field inspector on the McCormick Hotel included not only the control of the strength of the concrete, but also the inspecting and placing of steel reinforcement and the erection and removal of forms. The contractor made it a point not to remove any forms until test specimens indicated a strength of at least 1,600 pounds a square inch in the concrete involved.

The field inspector's duties consequently included the continuous inspection and testing of aggregates delivered to the work, taking test specimens of concrete, marking and storing the specimens, sending test specimens to the laboratory in accordance with the schedule, inspecting and checking the location, size and placing of steel reinforcement, checking the water-cement ratio, checking up the adequacy and alignment of form work, checking the time for the removal of forms as based on the strength of concrete involved, and numerous other duties incidental to the work.

## Plant Arrangement

An interesting detail of plant arrangement which may be seen in one of our photographic illustrations was a long ramp built from the street level to a level above the material hoppers, so that sand and gravel trucks could deliver those materials directly into hoppers. While this had no direct bearing on the speed of construction it did



*The structural frame as completed on December 15, 1926* eliminate the cost of providing elevating machinery and equipment for delivering sand and gravel to the hoppers.

The concrete mixer was buried under the hoppers, from which sand and gravel were delivered direct.

The progress of the work was most satisfactory, although carried on at a season of the year when protection against cold weather was imperative. Considerable cold weather occurred during the period up to December 15, 1926, when the structural frame was completed.

### Speed of Erection

The speed of the construction work on the structural frame and floors of this building is indicated by two photographs, one of which shows three stories of the frame completed on October 21, 1926. Another illustration shows the entire sixteen stories completed on December 15. Thus the period from October 21 to December 15, just under eight weeks, with two mid-week holidays intervening, saw the completion of thirteen stories of the structural frame and floors.

Counting Saturdays as half days and deducting the two holidays, there were 42 full working days in that period, so that the average speed for the thirteen stories was one story in a fraction over three days.

The best of co-operation prevailed between the inspecting company and the contractor, the Adolph Lindstrom Company, 77 West Washington Street, Chicago. This construction company, while required by the specifications to furnish such inspection, welcomes this method of procedure. First of all, when a provision of this nature is included in the specifications, competent and responsible bidders are protected against the possible intrusion of some concern of doubtful ability or reputation. It is not uncommon for such concerns to underbid responsible contractors with the expectation of making up the difference through inferior construction.

Another and perhaps more direct reason for this contractor's favorable attitude toward responsible field inspection is the fact that through this co-operation with an experienced inspecting company the final result is a better quality of work. This builds up a contractor's reputation for producing work of first quality, a reputation which soon spreads among the class of owners involved in large buildings of the investment type.

So far as cost of inspection is concerned, we are informed by R. A. Northquist, of the Lindstrom company, that the greater part of the cost of inspection was offset by the smaller quantities of cement permitted. A certain cement content was assumed as necessary to produce the assumed strength. When the work was sufficiently under way to indicate a considerable excess of actual strength over the assumed strength the contractor was permitted to cut down on the quantities of cement, and still was able to maintain strengths above the minimum specified.

The architect of the McCormick Hotel was Edmund J. Meles, 105 West Monroe Street, Chicago. Mr. Meles was personally on the work every day and maintained general supervision over the design, construction and inspection of this building. The structural design was prepared by Frank A. Randall, 160 N. La Salle Street, Chicago. As before stated, the contractor was the Adolph Lindstrom Company, 77 West Washington Street, Chicago, and the inspection work was under the supervision of D. B. Rush, of the Robert W. Hunt Company, 175 West Jackson Blvd., Chicago.

A silver cup is offered as a prize to the member company of the Associated General Contractors of America having the best accident prevention during the next six months. William F. Tubesing, president of the William F. Tubesing Company, Milwaukee, Wisconsin, is the donor.

## Medical Arts Building of Dallas to Be Enlarged

Plans are being completed for a reinforced concrete addition to the present Medical Arts Building of Dallas, Texas, a 19-story reinforced concrete structure which is utilized exclusively as offices for physicians, surgeons and dentists.

### Completed in 1923

The present Medical Arts Building, completed early in 1923, was at the time of its completion the tallest reinforced concrete building in the United States. This fact, coupled with its imposing architectural appearance, attracted considerable attention to this structure.

The architects of the present structure were Barglebaugh & Whitson, of Dallas, and the structural design was prepared by W. J. Knight & Co., of St. Louis.

## Ferrocrete Extends Distribution

Ferrocrete, a portland cement sold extensively in Great Britain and which has given unusually high early strengths has been available in seaboard cities for some time. The Ferrocrete Import Company of 250 W. 57th Street, New York City, announce that stocks are now being carried in the Great Lakes ports of Chicago, Niagara Falls and Buffalo.

# The A. B. C.'s of Good Concrete

## Some of the Factors That Affect the Quality of Concrete—Moisture in Aggregate Must Be Considered—How to Compute Moisture Content—Its Effect on Cost and Quality of Concrete

## Part II—The Bulking Effect of Moisture in Aggregates

Part I of this series of articles, describing some easily made field tests for aggregates, was published in the June issue. This was the first installment of a number of such articles, written for the non-technical man, on how to make good concrete.

Having learned how to select and test his aggregates, the next step is combining them properly. Several factors enter into this procedure, one of the first being the bulking effect of moisture in the aggregates.

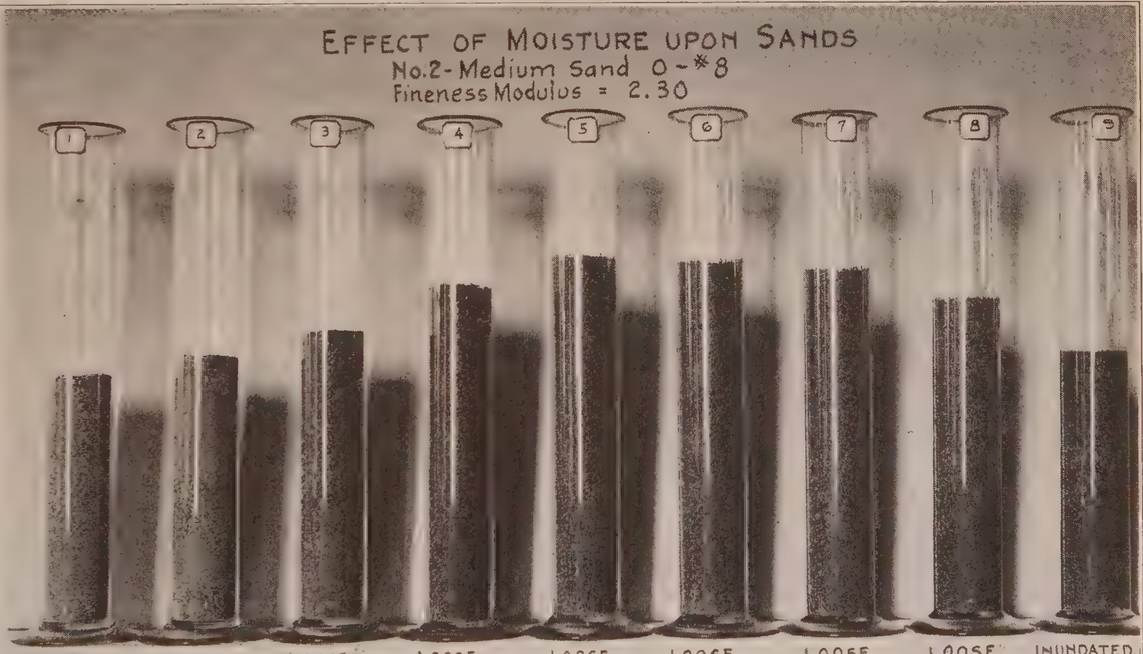
MOISTURE causes sand and gravel to swell in volume. If the concretor ignores this important fact, it is difficult to make quality concrete.

The moisture present in aggregates has a twofold effect. (1) It affects the amount of mixing water used, and (2) it changes the actual proportions of materials used to a greater extent than is commonly supposed. The first of these effects will be discussed in detail in a later chapter on the amount of mixing water to be used. The present chapter will consider the moisture content in aggregates only from the standpoint of proportioning the aggregates.

Proportions of concrete are almost always specified in terms of loose volume, as for instance, 1:2:4, measuring one part of cement to two parts of sand to four parts of gravel or crushed stone, measured by *volume*. As little as four per cent of moisture often swells the sand as much as 25 per cent in volume. Two cubic feet of wet sand would therefore really be less than the specifications intended. The proportions actually would be 1:1.6:4 instead of 1:2:4, as specified. We shall see later how this figure was arrived at.

### How This Affects the Concrete

Changing the proportions in this manner by not taking into account the moisture in the sand, will affect the resulting concrete in several ways. While a 1:2:4 concrete,



| | DRY RODDED | DRY LOOSE | LOOSE | LOOSE | LOOSE | LOOSE | LOOSE | LOOSE | INUNDATED. |
|---|---|---|---|---|---|---|---|---|---|
| %Water (by Wgt) | 0 | 0 | 1 | 2½ | 5 | 7½ | 10 | 15 | 20 |
| % Bulking | 0 | 5.82 | 15.2 | 34.5 | 43.3 | 41.0 | 38.6 | 24.6 | 2.3 |
| % Loss per Cu.Ft. | 0 | 5.2 | 13.2 | 25.6 | 30.2 | 29.0 | 27.7 | 19.7 | 2.2 |
| Wgt. per Cu.Ft. (Incl. water) | 108.0 lb | 102.0 | 94.5 | 82.4 | 79.3 | 82.4 | 85.8 | 99.5 | 127.0 lb. |
| Wgt. Dry Sand in 1 Cu.Ft. | 108.0 lb. | 102.0 | 93.6 | 80.4 | 75.5 | 76.6 | 78.0 | 86.6 | 106.0 lb. |

All percentages based on Tube No.1-Dry Rodded Sand.

*Photograph of tests illustrating the bulking effect of moisture in sand. When enough moisture has been added to inundate the sand as in tube No. 9, the sand occupies practically the same volume as when dry* proportioned on the basis of dry sand, will have enough mortar to fill the voids in the coarse aggregate and make the concrete workable and easy to finish, a reduction in the amount of sand might make the concrete harsh and hard to finish. This is actually what is done when the bulking effect of moisture in the sand is not taken into consideration.

Another important influence of the swelling of aggregates due to moisture is the fact that when concrete is proportioned on the basis of wet material instead of dry, considerably less concrete results. For instance, the decrease in the amount of 1:2:4 concrete is around seven per cent. The contractor suffers this loss, generally without knowing it.

### How to Determine Amount of Bulking

The bulking of aggregates can easily be determined in the field. Very little equipment is necessary and the computations are simple.

First fill a convenient measure having vertical sides (a box will do) full of the aggregate to be tested. Try to imitate actual job conditions as much as possible in selecting and handling the sample. Fill the measure to the top and strike it off level full.

Carefully preserve this entire sample and dry it. Then replace the dry sample in the box, level it off and measure the distance from the top of the box to the top of the sample. You now have enough information to compute the bulking.

For Example: Say that your measuring box has a depth of eleven inches. When a box full of sand has been dried and put back in the box, it lacks 2¼ inches of reaching the top. The depth of the dry sand is therefore, 8¾ inches.

To determine the percentage of bulking, divide the loss in height (2¼ inches) by the height remaining in the box (8¾ inches). The result is the percentage of bulking.

$$\text{Thus } \frac{2.25}{8.75} = 0.26 = 26 \text{ per cent.}$$

The percentage of moisture in the sample is the loss in weight divided by the weight of the dry sample.

Now, when we know the *amount* of bulking, we must correct our proportions to allow for this bulking. Let us assume that we are using the 1:2:4 mix as used before, and that the 26 per cent of bulking just determined referred to the sand as delivered on the job. What will our field proportions be to get a 1:2:4 mix based on *dry* measurements?

With 26 per cent bulking, the equivalent of two cubic feet of dry sand would occupy a volume of .26 x 2 or 2.52 cubic feet. Our field proportions would then be 1:2.52:4 with the correction made for the bulking in the sand.

If crushed rock is used for the coarse aggregate, there will be little or no bulking due to moisture. If gravel is used, a sample should be tested for bulking as described above and the coarse aggregate volume corrected as has already been done for the sand.

### Increased Strength and Yield

Some concretors may jump to the conclusion that when concrete is proportioned on the basis of dry sand rather than moist sand they are adding more sand to the concrete and therby making it weaker. But tests show that the addition of sand to the mix to the extent required to gain workability, actually increases the strength. In addition, when the moisture content of the aggregates is known and allowed for stronger concrete will result because of the lower water cement ratio.

### Dry and Damp Sand Tests

Some interesting tests were reported by the U. S. Bureau of Public Roads on the relative strengths and yields of concrete made with damp sand and with dry sand.

1:2:4 CONCRETE

| | Dry Sand | | Damp Sand | | Effect of Using Dry Sand | |
|---|---|---|---|---|---|---|
| Size of Stone Inches | Strength | Vol., cu. in. | Strength | Vol., cu. in. | Increased Strength Per Cent | Increased Volume of Concrete Per Cent |
| ¼ to 1½ | 2,070 | 385 | 1,850 | 360 | 11.9 | 6.9 |
| ¾ to 1½ | 1,800 | 374 | 1,680 | 350 | 7.1 | 6.8 |

These results indicate the advantages that follow when the moisture content in aggregates is taken into consideration. Not only did more concrete result, but higher strengths were obtained by using proportions based on dry sand rather than wet sand. To the contractor the increased concrete yield of 7 per cent is just that much financial gain. These are the advantages of measuring accurately and allowing for the moisture in the aggregate, even when the water content is not definitely specified. Where concrete strength is predetermined by means of the water cement ratio, the determination of the moisture in the sand is doubly necessary as will be pointed out in a later chapter.

### Change in Moisture Content

All aggregate as delivered on the job contains some moisture. Under varying conditions of weather and storage the moisture content, of course, changes. Tests should be made often enough to guard against any changes in moisture content with changes in the weather, changed sources of supply or altered storage conditions.

---

## Interest in Safety Grows Among Contractors

Reports received at the national headquarters of the Associated General Contractors of America indicate that many branches and chapters are taking up the practice of holding special meetings for the discussion of accident prevention methods.

The Dayton chapter of the organization, cooperating with the Building Trades Council and the Dayton Builders' Exchange, held a mass meeting Wednesday, May 18th, in the interests of accident prevention. Several thousand attended. Thomas Kearns, superintendent of the Ohio State Safety Department, and safety engineers of his staff were the speakers.

As its first step, the Milwaukee, Wisconsin, chapter is posting large signs on jobs, warning workmen of the need of caution. A manual is to be published calling attention to the dangers of the industry and methods of avoiding accidents. A series of classes in accident prevention is also being planned by S. H. Eigel, Executive Secretary of the unit.

Members of the Dallas, Texas, chapter at a recent meeting heard Dr. W. J. Senton lecture on safety and accident prevention, while an assistant demonstrated the application of first aid. Dr. Senton has charge of a first aid instruction car making a tour of Texas.

# Flexibility of Concrete Poles

## Some Interesting Deflection Tests Made on Concrete Poles 30, 35 and 45 Feet Long

A SERIES of tests on reinforced Hollowspun concrete poles made by the Westinghouse Electric & Mfg. Co. at their Milwaukee plant proved conclusively that concrete poles can be designed for definite working loads with very uniform results. While these tests were conducted mainly to obtain the deflection data very much in demand by interested engineers, they also created considerable interest among numerous engineers and officials witnessing the tests by their remarkable flexibility and ability to withstand punishment without harm to the poles.

### Special Tests on a 30-Foot Trolley Pole

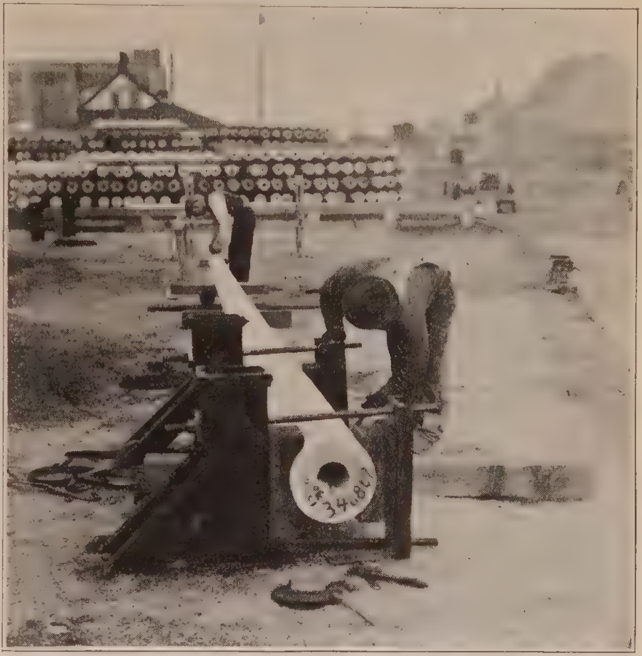
The entire series of tests, which included 34 distribution poles of 30-foot, 35-foot and 45-foot lengths and 12 lighting standards, took over a month to complete. While the tests were under way a cyclone caused considerable damage to a number of wooden poles in the city of Milwaukee and, knowing of the tests, the Milwaukee Electric Railway and Light Co. asked for a demonstration on an old concrete pole taken from stock. The pole was placed in position for testing as described later in this article and a load of 750 pounds applied to the top of the pole. This was the recommended working load for this particular type of pole. The cable holding the load was then cut and the pole sprung back into a straight line. It showed no permanent deflection.

The load was again applied up to 1500 pounds, the maximum working load, the pole this time having a deflection of ten inches. On cutting the cable the pole again sprang back into a straight position without any effect on the pole whatever. Officials and engineers from other utility companies were present at this test. In order to see what effect sudden impacts on a trolley wire or the pole would have, they asked to have the pole pulled up again to the 1500-pound loading. The cable was then struck a number of times with a piece of timber and the pole was struck at the ground line with a 12-pound sledge first on the compression side and then on the tension side. Aside from a denting and slight chipping of the concrete under repeated blows of the sledge, no damage was done to the pole. The pole was then tested to failure with the ultimate load as high as usual.

### Method of Testing

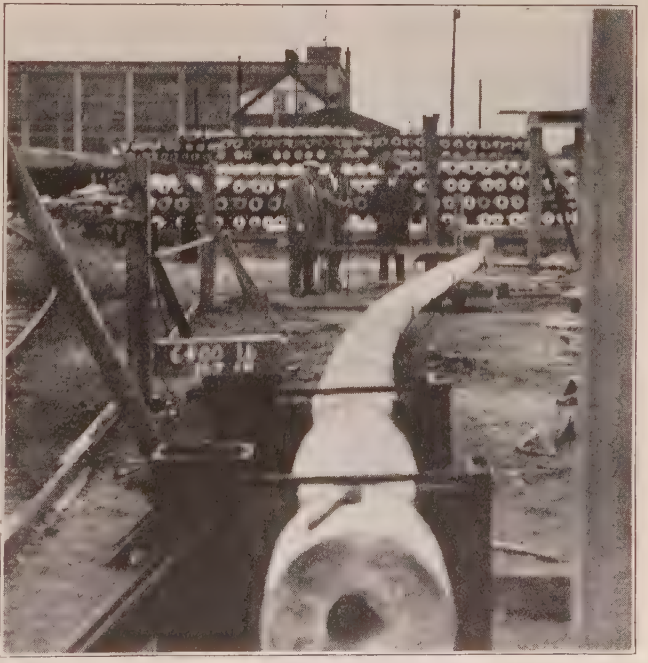
The tests were made with the butt of the pole held in a rigid position for a length corresponding to the depth the poles were placed in the ground in general practice. For the 30-foot poles, this length was 5 feet 6 inches, leaving 24 feet 6 inches of the pole above the ground line. The load was applied 24 inches from the top of pole by means of a 3-ton hoist and readings were taken at 5-foot intervals along the pole and 6 inches from the top of the pole. Deflections were read on 250- and 500-pound loadings, measured by a dynamometer with release readings after the recommended working load had been reached.

The poles were tested in a horizontal position with the upper end of the pole supported on a ball bearing dolly. A piano wire kept taut by means of a spring was attached securely to the butt end of the pole and extended over the center of the pole for its full length and attached to a sleeve on a horizontal bar some distance beyond the top end of the pole. To compensate for any crushing of the wooden blocks holding the butt in place, the wire could be brought to its correct position by lining up the wire over the center of the pole at the ground line before each deflection reading.


*Method of holding the butt end of the pole during testing*

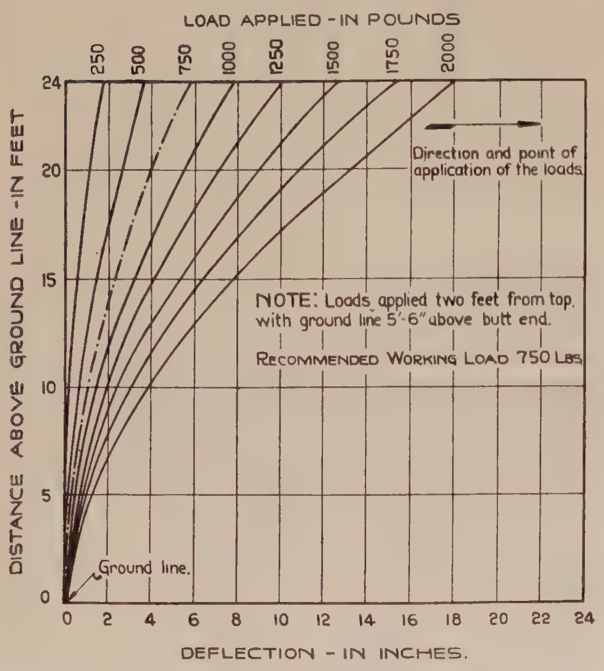
### Manufacturing Process

The poles tested were made by the centrifugal process in a horizontal position. The spinning of the pole with a


*A deflection of 61.7 inches at the ultimate load of 6400 lbs.*

Class 750-30 Ft. Hollowspun Concrete Poles

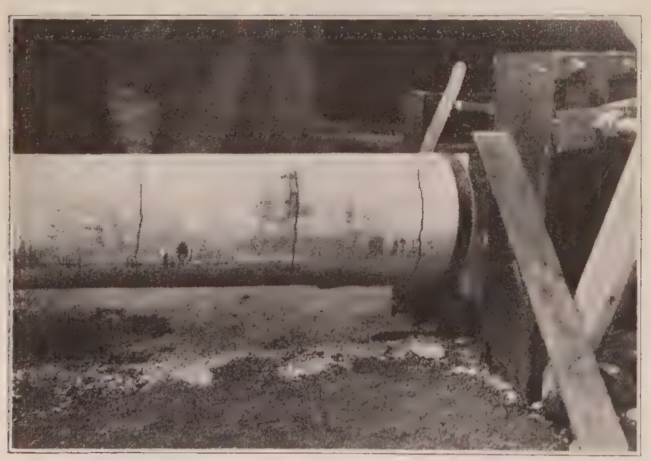
Curve showing deflections for the various loads applied 22'-6" above ground line.



fixed amount of wet mixed concrete in the forms produced a hollow opening throughout the length of the pole and drew off the excess water to the center, leaving a compact concrete with a very low water-cement ratio. A basic mix of one part of cement to one part of sand and two parts of gravel by weight with a combined fineness modulus of 4.5 was used. The poles tested had been steam-cured for three hours and then cured in the shop at shop temperatures. The reinforcing consisted of steel reinforcing rods with spiral wrappings to take care of shear, the amount of steel and pitch of the wrapping varying with each type of pole tested. Concrete buttons held the reinforcing cage in place during the spinning process.

## Conclusions

On release of the load before the elastic limit was reached, the pole would return to its original position with a deflection reading generally less than an inch. Tension cracks that appeared under excessive loadings below elastic limit closed upon release of the load, disappearing completely from view.

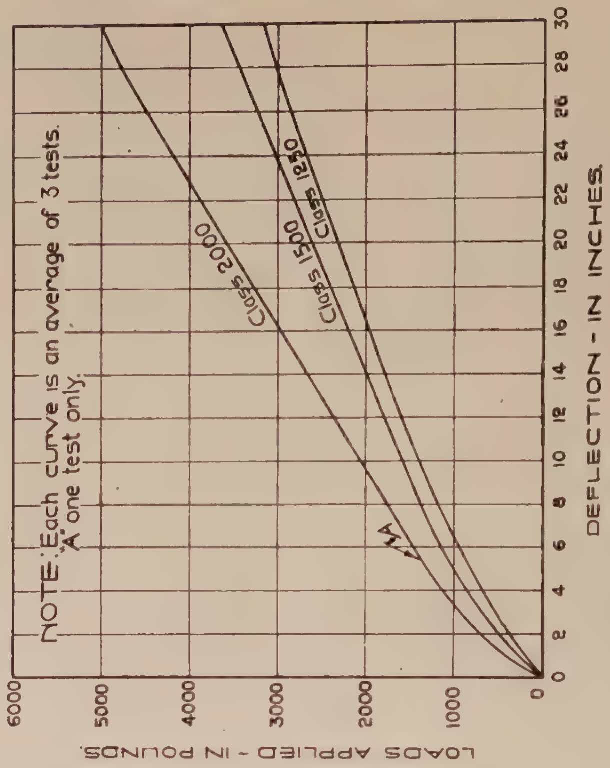


*Typical tension failures at ultimate load*

There was no definite break in the pole at ultimate load.

45 Ft. Hollowspun Concrete Poles.

Curves showing deflections for the various types of 45 ft. poles.

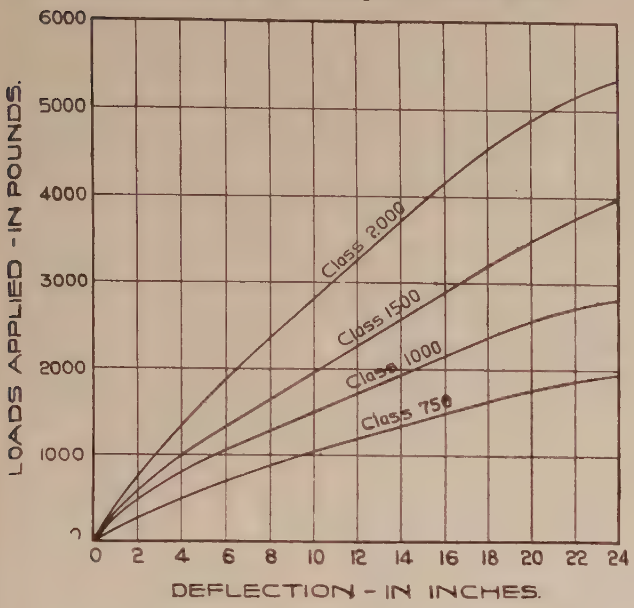


There was only a slight opening of the tension cracks in the concrete as the steel was stressed beyond the elastic limit and a slight crushing of the concrete in compression generally opposite the greatest tension failure as the pole was pulled over beyond ultimate load.

After failure of the pole occurred at ultimate load, the pole would still hold a load within a few pounds of the ultimate loading. Upon release of this ultimate load, the pole would return toward its original position with only a relatively small permanent deflection. Even after the pole had been tested to failure, it would take a load in the opposite direction nearly equal to the original loading.

*39.5 inches deflection at ultimate load of 2150 lbs.*

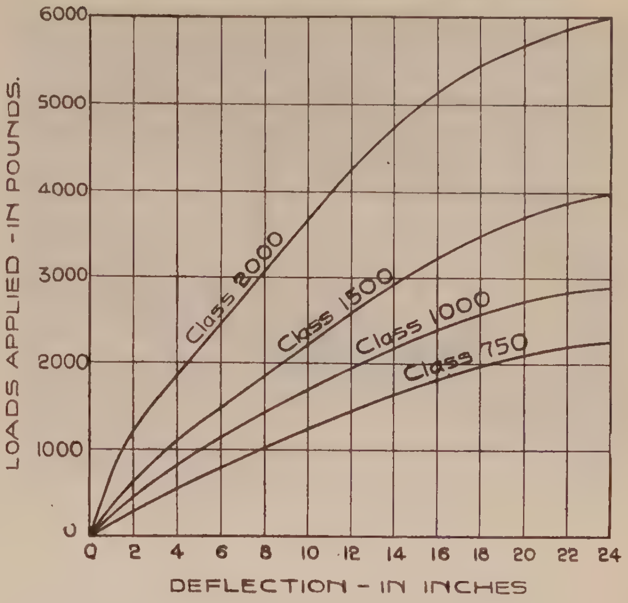
Sudden release of the load similar to the snapping of a cable only tended to improve the behavior of the pole, apparently giving the pole more life as it whipped back into position. Poles over a year old gave less deflection



35 FT. HOLLOWSPUN CONCRETE POLES.

CURVES SHOWING DEFLECTIONS FOR THE VARIOUS TYPES OF 35 FT. POLES.

NOTE: The class referred to is the recommended working load applied two feet from top with pole anchored 5'-6" above the butt end. Each curve is an average of three tests



30 FT. HOLLOWSPUN CONCRETE POLES.

CURVES SHOWING DEFLECTIONS FOR THE VARIOUS TYPES OF 30 FT. POLES.

NOTE. The class referred to is the recommended working load applied two feet from top with pole anchored 5'-6" above the butt end. Each curve is an average of three tests.

## TABLE GIVING TECHNICAL DATA FOR THE VARIOUS TYPES OF HOLLOWSPUN CONCRETE POLES.

| Class No | Length of Pole Ft. | Diameter of Pole | | Weight of Pole lbs | Recommended Working Load Safety Factor = 3.0 | | | Maximum Working Load Safety Factor = 1.5 | | | Calculated | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Top ins. | Butt ins. | | Load lbs. | Deflec. ins. | Max. Bending Moment Ft. lbs | Load lbs. | Deflec. ins. | Max. Bending Moment Ft. lbs. | Elastic Limit lbs. | Ultimate Load lbs. |
| 750 | 30 | 5¾ | 13¼ | 2100 | 750 | 5.8 | 16800 | 1500 | 12.7 | 33800 | 1875 | 2250 |
| 1000 | 30 | 7 | 14½ | 2800 | 1000 | 5.05 | 22500 | 2000 | 12.63 | 45000 | 2500 | 3000 |
| 1500 | 30 | 7 | 14½ | 2900 | 1500 | 6.1 | 33800 | 3000 | 14.2 | 67500 | 3750 | 4500 |
| 2000 | 30 | 8¼ | 15¾ | 3600 | 2000 | 4.68 | 45000 | 4000 | 11.25 | 90000 | 5000 | 6000 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 750 | 35 | 5¾ | 13¼ | 2500 | 750 | 6.83 | 20200 | 1500 | 16.4 | 40500 | 1875 | 2250 |
| 1000 | 35 | 7 | 14½ | 3600 | 1000 | 5.53 | 27000 | 2000 | 14.6 | 54000 | 2500 | 3000 |
| 1500 | 35 | 7 | 14½ | 4000 | 1500 | 7.27 | 40500 | 3000 | 16.58 | 81000 | 3750 | 4500 |
| 2000 | 35 | 8¼ | 15¾ | 4900 | 2000 | 6.78 | 54000 | 4000 | 15.43 | 108000 | 5000 | 6000 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 1250 | 45 | 7 | 18¼ | 5900 | 1250 | 8.91 | 45000 | 2500 | 22.13 | 90000 | 3150 | 3750 |
| 1500 | 45 | 7 | 18¼ | 5900 | 1500 | 9.3 | 54000 | 3000 | 23.72 | 108000 | 3750 | 4500 |
| 2000[A] | 45 | 8¼ | 19½ | 7100 | 2000 | 9.6 | 72000 | 4000 | 22.9 | 144000 | 5000 | 6000 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 750[B] | 30 | 5¾ | 13¼ | 2100 | 750 | 3.93 | 16800 | 1500 | 10.27 | 33800 | 1875 | 2250 |
| | | | | | | | | | | | | |

NOTE: All deflections are an average of 3 tests.
"A" Only one test.
"B" Poles taken from stock one year old.

GROUND LINE TO BUTT END.
30'-0" = 5'-6".
35'-0" = 6'-0".
45'-0" = 7'-0".

corresponding to a 250-pound difference in loadings compared to poles three months old.

The deflection data for the various types of poles tested are shown with a few of the curves that have been prepared. The complete report is under preparation by the Westinghouse Electric & Mfg. Co. and will prove of real value to engineers interested in distribution, railroad and public utility work. The plant at Milwaukee, together with the plants at Valdosta, Ga., and St. Louis, Mo., makes three concrete plants that the Westinghouse Electric & Mfg. Company now have in operation.

*Typical crushing in compression after pole is pulled beyond ultimate load*

## Crozier, Straub Suing New Jersey Manufacturers

Four suits are now being tried in the United States district court at Trenton, New Jersey, before Judges Bodine and Rellstab, in which Crozier, Straub, Inc., is the plaintiff. The firm is suing the Hudson County Fireproof Block Company for royalties under a patent held by the plaintiff company. The Hudson company was a licensee under the patent.

Three patent infringement suits are being tried in which Crozier, Straub is the plaintiff against Theodore Graham, Jacob Melmond, and Robert G. Dower, South Jersey manufacturers of concrete block. It is said that the three defendants infringed a patent held by the firm. An accounting of profits accruing and damages sustained is asked.

## $20,000,000 Road Construction Program for Argentina

According to a mail communication recently received from Buenos Aires, the municipality of that city has set aside $20,000,000 (paper) for the construction of new highways of macadam or concrete. Consequently it is thought that a good market for cement will shortly be created in Argentina. There is only one local factory capable of supplying the material in bulk, its manufacture having hitherto proved too costly for its general adoption for road surfaces in this South American republic. Engineers dispatched by the Buenos Aires municipality to the United States and Europe to study the construction of concrete roads suitable for a large city have reported favorably on their adoption for Buenos Aires.

## Sand-Lime Brick Production for 1926 Reported

Washington, D. C.—The Department of Commerce announces that, according to data collected at the annual census of sand-lime-brick production taken in 1927, 42 establishments, which were in operation on an average of 217 days in the year, reported the production, in 1926, of 330,586 thousands of brick, valued at $3,981,492. This represents increases of 4.8 per cent in quantity and 5.3 per cent in value as compared with 315,595 thousands, valued at $3,780,639, reported for 1925, and of 16.6 per cent in quantity and 19.4 per cent in value as compared with 283,417 thousands, valued at $3,334,503, reported for 1924.

Summary statistics are presented in the following statements. The figures for 1926 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

TABLE 1—PRODUCTION, BY QUANTITY, AND VALUE, STOCKS ON HAND BY QUANTITY, FOR THE UNITED STATES: 1926, 1925 AND 1924

| | | | | Pct. incr. or decr. (—) | |
|---|---|---|---|---|---|
| | 1926 | 1925 | 1924 | 1925-1926 | 1924-1925 |
| Number of establishments† | 42 | 42 | 37 | * | * |
| Sand-lime brick: | | | | | |
| Production— | | | | | |
| Thousands | 330,586 | 315,595 | 283,417 | 4.8 | 11.4 |
| Value | $3,981,492 | $3,780,639 | $3,334,503 | 5.3 | 13.4 |
| Stocks on hand on Dec. 31, thousands | 22,033 | 23,599 | 21,717 | —6.6 | 8.7 |

---

*Not computed where base is less than 100.

†California, 1 establishment; Connecticut, 1; District of Columbia, 1; Florida, 3; Indiana, 1; Louisiana, 1; Massachusetts, 2; Michigan, 13; Minnesota, 4; New Jersey, 3; New York, 3; Ohio, 2; Pennsylvania, 2; South Dakota, 1; Texas, 2, and Wisconsin, 2. Of the 42 establishments reported as having produced sand-lime brick in 1925, 3 were reported as out of business and 1 as idle in 1926. Four new establishments reported production for 1926.

TABLE 2—SAND-LIME BRICK: PRODUCTION, STOCKS ON HAND, AND AVERAGE NUMBER OF DAYS IN OPERATION, FOR THE UNITED STATES, 1914 TO 1926, AND FOR STATES, 1926

| | Production | | | |
|---|---|---|---|---|
| State | Quantity (thousands) | Value | Stocks on hand Dec. 31 (thousands) | Average number of days in operation |
| United States: | | | | |
| 1926 | 330,586 | $3,981,492 | 22,033 | 217 |
| 1925 | 315.595 | 3,780.639 | 23.599 | * |
| 1924 | 283,417 | 3,334,503 | 21,717 | * |
| 1923 | 213.425 | 2.471.536 | * | * |
| 1921 | 97,126 | 1,268.502 | * | * |
| 1919 | †146.947 | †1,705.163 | * | * |
| 1914 | †172.629 | †1,058.512 | * | * |
| Florida | 19,743 | 223,896 | 379 | 275 |
| Michigan | 108,434 | 1,341.284 | 6.424 | 260 |
| Minnesota | 12,389 | 124,265 | 2,855 | 129 |
| New Jersey | 49,854 | 585,703 | 1.630 | 254 |
| New York | 11,510 | 158,283 | 2,058 | 183 |
| ‡Other states: | | | | |
| (Connecticut, District of Columbia and Mass.) | 58,944 | 764,197 | 2,638 | 264 |
| (Indiana, Ohio, Penn.) | 32,412 | 375,956 | 4.536 | 178 |
| (Louisiana and Texas) | 12,211 | 151,778 | 309 | 271 |
| (California, So. Dakota and Wisconsin) | 25,089 | 256,130 | 1,204 | 222 |

---

*No data.

†Marketed. (Data obtained from reports of U. S. Geological Survey.)

‡Statistics from these states cannot be shown separately without disclosing the operations of individual establishments, but some of them reported larger values of products than were reported by some of the states shown separately.

# Railroad Places Controlled Concrete

## Concrete Made Under Water-Cement Ratio Control on Grade Separation Structures of the Chesapeake and Ohio

RAILWAY engineers are coming to realize the advantages of water-cement ratio specifications for concrete structures in order to obtain uniform strength and surface finish. The latest and most conclusive evidence of this is the action at the recent convention of the American Railway Engineering Association in adopting a water-cement ratio specification, submitted by the Masonry Committee.

This action, of course, breaks away from the method of arbitrary proportions and is a marked forward step. Previous to the adoption of the new specification by the A. R. E. A., however, many railway engineers had tried out this basic method under field conditions.

In 1925, the Engineering Department of the Chesapeake and Ohio decided that their past methods, although yielding satisfactory results, might be improved. To this end it was arranged for a trial of a new procedure on an undergrade crossing at Russell, Kentucky, then in construction.

The Russell structure carried 6 tracks over Ferry Street, 30-foot roadway, two sidewalks and 13 feet minimum clear headroom. Longitudinal and transverse sections are shown. On one side the approach was on a curve. A continuous concrete guard was there cast on street center line to confine each direction of traffic to its proper lane and thus prevent collisions with the center bent.

### Change Specifications

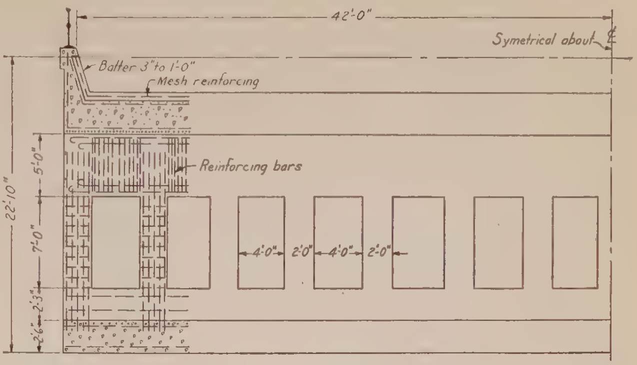
This work had already been started on an arbitrary 1:2:4 specification. A mixture with 6 gallons of water was designed to give a 28-day strength of 2500 pounds per square inch. The results on test cylinders averaged slightly better than 3000 pounds.

The experience at Russell seemed to justify the decision to give these newer methods a further trial on the overhead crossing at Neville Street at Beckley, West Virginia. Here, also, a contract had been awarded on an arbitrary specification and a similar field adaptation was made. The contractor found that this change did not increase costs and he gave his hearty co-operation. This concrete was also mixed on the basis of 6 gallons of water per sack of cement and the test cylinders here gave an average 28-day strength of a little over 3600 pounds per square inch.

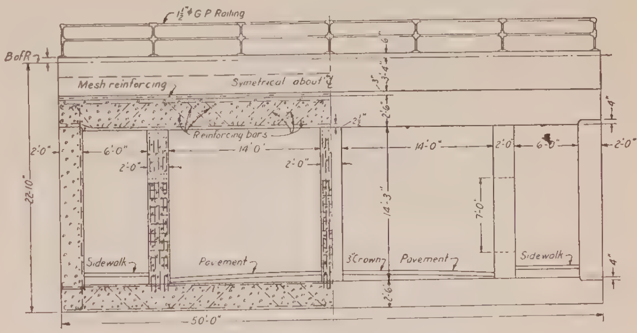
The results at Russell and Beckley were so encouraging that it was a logical step to write a water-cement specification for an underground crossing which was put in at Marmet, West Virginia, during the summer of 1926. This was a reinforced concrete structure, carrying the double track main line of the Chesapeake and Ohio over the important state road between Marmet and Malden. This underpass has gravity abuttments and precast reinforced concrete deck slabs. It consists of two spans providing two 14-foot driveways and 14-foot overhead clearance. The crossing is on a 70-degree skew.

### Strength of Concrete Specified

It was decided that concrete should be designed for a minimum strength of 2500 pounds per square inch at 28 days. Moisture determinations were made as to the amount of water contained in the fine and coarse aggregates. Tests were made to obtain the bulking effect of the sand, due to moisture. The fineness moduli were found for both aggregates. From this information trial mixes were made to verify the calculated amounts of aggregates to use to the fixed amount of water and cement necessary for 2500-pound strength at 28 days. Tests on cylinders of these trial batches again proved the mixture designs. Specifications stipulated the following amounts of water per bag of cement for the different classes of concrete on various parts of the structure.



PART LONGITUDINAL SECTION



CROSS SECTION

*Showing the design of the subways made with quality controlled concrete*

The essence of the water-cement specification was as follows:

| Gals. of Water per Bag of Cement | Strength Pounds |
|---|---|
| 4.7 | 3500 |
| 5.2 | 3000 |
| 5.9 | 2500 |
| 6.7 | 2000 |
| 7.6 | 1500 |

| Type of Concrete | Maximum Slump, In. |
|---|---|
| 1. Mass Concrete | 3 |
| 2. Reinforced Concrete— | |
| (a) Thin vertical sections and columns | 6 |
| (b) Heavy sections | 3 |

| | |
|---|---|
| (c) Thin confined horizontal sections | 8 |
| 3. Roads and Pavements— | |
| (a) Hand finished | 3 |
| (b) Machine finished | 1 |
| 4. Mortar and Floor Finish | 2 |

The structure was built in accordance with the specifications and tests as above outlined and the results were very gratifying.

Mr. C. W. Johns, Chief Engineer, and Mr. Crosby Miller, Bridge Engineer, are the officials who are primarily responsible for the initiation of this advance in concreting practice on the Chesapeake & Ohio.

# Products Machinery Makers Consolidate

### Progress of the Concrete Products Industry Reflected in $1,000,000 Machinery Consolidation — Five Concerns Combine Forces—Plans for the Future—Probable Effects on the Industry

FOR the last year or two there have been many evidences that the concrete products business was becoming an industry—that it was beginning to consolidate its rapid gains, and to develop a business outlook in harmony with the enormous output of the industry as a whole.

Now comes more conclusive evidence of this new state of affairs in the concrete products industry. A group of the foremost machinery manufacturers serving it—the Anchor Concrete Machinery Company of Adrian, Michigan; the Ideal Concrete Machinery Company of Cincinnati, Ohio; Thomas W. Noble and Company of Chicago; the Universal Tamping Machinery Company of Peoria, Illinois; and the Adrian Casting Company of Adrian, Michigan—have joined together under the name of the Consolidated Concrete Machinery Corporation to form one large firm to adequately meet the present day demands.

All of the companies forming this combination, with the exception of the Adrian Casting Company are well known to products manufacturers. Each of them has been serving the industry for many years, and each has backed up its own line of machinery with an honest attempt to render constructive service to the men who were using its equipment. All of them have been developing and improving their machinery from time to time as opportunity offered, and all of them have been rewarded with a considerable success. And now they have found it expedient to combine their resources in order to better serve their own interests and those of the industry to which they furnish machinery. Although for the present, each of the companies involved will continue to manufacture and sell its present line of equipment, it is probable that the combining and comparing of the engineering data of the group will result in further improvements, and a certain tendency toward uniformity in the types of machinery which they manufacture. The line of each company has today its own peculiar points of superiority, and possibly certain points that will bear improvement as well. It would not be at all surprising if within the next few years there would be developed from the comparative study of these machines a composite type more generally satisfactory to the rank and file of the products industry than anything which is now available to them.

There will be, of course, less duplication of effort, and probably a larger field organization, able to keep in closer touch with the industry. We understand that the immediate program of the new company involves the appointment of field engineers in various parts of the country whose duties will be largely those of consultants to the products industry. The engineering and sales departments of the corporation will be housed in a new office building just completed at Adrian, Michigan, and plans are under way for the establishment of a complete testing laboratory, the services of which will be available to the trade at large.

Doubtless this consolidation will also have its effect upon those manufacturers of concrete products machinery not involved in it. The plans being made by the new corporation for enlarged service facilities will no doubt find their reflection in similar developments on the part of other manufacturers. Any machine improvements that may be made by the new corporation will in all likelihood prove a stimulus to other manufacturers, and possibly result in new and better types of machinery.

Powerful as is the new organization, it has by no means eliminated competition, nor is it apt to do so. What it will more probably accomplish is to put competition more on a plane of service and machine performance, and out of the field of high pressure selling that has unfortunately at times characterized the products machinery business in the past.

The officers of the new corporation are recruited from the administrative staffs of the former companies. They are as follows: President and General Manager, Eugene F. Olsen, formerly General Manager, Anchor Concrete Machinery Company; Chairman of the Board, J. W. Freiberg, formerly President, Ideal Concrete Machinery Company; Vice-President, G. F. Alderdice, President, Commercial Shearing and Stamping Company, Youngstown, Ohio; Secretary-Treasurer, S. S. Davenport, formerly Treasurer, Anchor Concrete Machinery Company.

These officers, with the following, comprise the Board of Directors: Thomas W. Noble, formerly President, Thomas W. Noble & Company; Isaac Bassett, formerly President, Adrian Casting Company; W. H. Burnham, pioneer fence manufacturer and now President of the Michigan Manufacturers Association, and I. C. Bradbury, of Grand Rapids, Michigan.

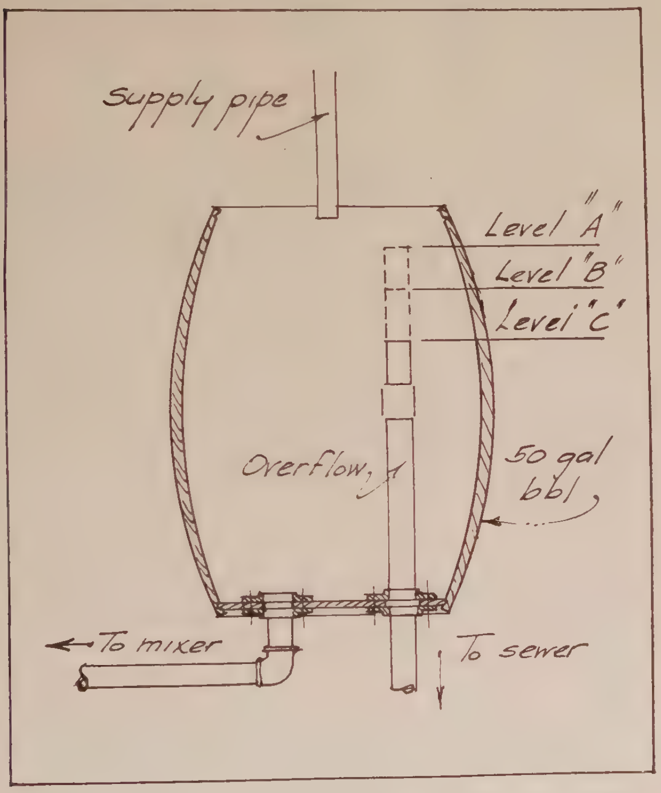
The only company involved in the consolidation not already well known to our readers is the Adrian Casting Company of Adrian, Michigan. This company has occupied itself for several years with the making of grey iron and semi-steel castings for use in concrete products machinery, and its inclusion in the new corporation will provide a convenient source for the thousands of castings necessary in the manufacture of the elaborate line of machinery now produced by the Consolidated Concrete Machinery Corporation.

# Practical Kinks from the Job

## A Simply Made, Accurate Water Measuring Device

WHERE it is desired to control the amount of mixing water used in accordance with the water-cement ratio law, and the job is not large enough to warrant the investment involved in the purchase of a regular water measuring tank, a convenient arrangement can be worked out with the ordinary 50-gallon wooden water barrel so frequently used for holding or measuring the water for each batch of concrete.

Depending on the size of the batch to be run, a minimum quantity of water is determined. For a five-bag batch the lowest water ratio likely to be used on the building under construction would be, say, 6 gallons per sack of cement. The maximum moisture likely to be carried by the sand would be, say, 7 per cent. The mix would be, we will say, a 1:2:4, or approximately 10 cubic feet of sand per 5-bag batch. As the sand may bulk up to 30 per cent in handling in a damp condition, we will say that this 10 cubic feet represents only 70 per cent of the sand volume actually desired, and to get the full 10 feet specified we would therefore have to put into the charging hopper $\frac{10}{7} = 14$ cubic feet of damp, loose sand. Assuming the sand to weigh about 100 pounds per cubic foot in this condition, 7 per cent of the 1400 pounds which the 14 cubic feet would weigh would be 98 pounds, or approximately 12 gallons. This, then, is the maximum amount of moisture in the aggregate for which we may have to make allowance. So we subtract the 12 gallons from the 30 gallons specified (5-sack batch at 6 gallons per sack) and arrange to set the overflow pipe on the water barrel at 18 gallons.



The overflow pipe is placed in the barrel and 18 gallons measured into the barrel. The water level is then marked on the pipe. The pipe is cut off about 1 inch below this point, threaded, and a coupling turned down on the pipe until the top of the coupling is exactly at the 18-gallon level. It is then made fast by soldering or any other simple method, such as drilling and bolting.

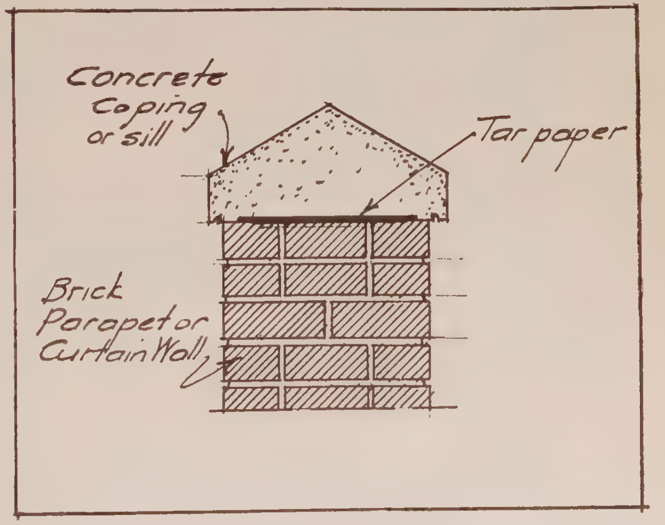
A series of pipe nipples is now cut, each one being long enough to raise the overflow level the difference between levels "A," "B," "C," etc., being 2 gallons, or 1 gallon, as desired, depending on how close a degree of control is going to be exercised. A series of 20d nails is then driven into the side of the aggregate bin or any other convenient surface and one nipple slipped over each nail, the number of gallons that the water barrel will hold when each particular nipple is used being marked on the nipple and below the nail on which it is to be hung when not in use.

Just as with other measuring devices, it is still up to the superintendent or inspector to see that no more than this amount of water is used by educating and watching the mixer man and by imposing disciplinary action if necessary to get obedience to instructions.

## Preventing Concrete from Lifting Brick Course

In casting a concrete coping on a brick parapet wall, or a concrete sill on a brick curtain wall, trouble will often be experienced with the concrete lifting up the top course of brick as it sets.

This can easily be avoided by covering the brickwork with a strip of waterproof building paper, or a piece of tarred felt, cut about 2 inches narrower than the width of the wall. This piece of paper or felt serves to keep the concrete from lifting the brickwork, while the inch of the brick in the top course which is left exposed is enough to bond the sill or coping to the wall.



The sketch shows a cross-section of such a wall with the parapet in place, and the tar paper (much exaggerated as to thickness) on top of the brickwork.

# *Here and There*

## Some Random Notes on Visits with Concretors in the Field

EVER notice, as you traveled through the country, how easy it was to spot the communities that had real, live concrete products plants? Even a stranger, entering a city, can almost tell whether the concrete products industry in that town is a live issue or not.

When you drive through some towns and see the new construction going on; here you spot a concrete block and stucco residence going up; there is a church using concrete trim stone; in the downtown section is a reinforced concrete office building with concrete tile partition walls. It's a cinch that in this town there is at least one live products manufacturer—probably several.

And when you talk to these products men and see their plants, you know at once why this is a good community for concrete products. Inevitably a quality product is made and it is *merchandised.*

There is the secret in a nutshell.

* * *

BUT there are locations where you can ride through one town after another and nary a concrete block can be seen.

What a field such localities would offer to an enterprising products man—one who had a vision of what a quality product, properly promoted and sold would do to the building industry of such a community!

There is still a wealth of opportunity for expanding the concrete products field. In some towns the builders do not even know that quality concrete block, tile, and trimstone can be made!

* * *

EVER see a good looking concrete tombstone? We did, not long ago, in a progressive southern city. You could not tell the concrete tombstone from one made of the natural marble quarried in the vicinity.

It was polished up, cut and carved to perfection. No wonder there is a considerable market for these products in that town. And the concrete stone will sell for almost half the price of a marble stone!

* * *

THIS same manufacturer built a mausoleum of concrete trimstone that is the talk of the community. The owner had a definite idea of what he wanted. Marble, even though it was conveniently available, proved to be too expensive. So estimates were made using artificial stone.

The mausoleum was built at a cost $6,000 below the marble estimate and the owner is tickled pink.

* * *

IT is surprising how versatile a machine can be! We saw one the other day in a products plant in a suburb northwest of Chicago. That machine could do almost anything but carve trimstone.

As a matter of fact it could make some types of coping, keystones, etc. But its big production lies in hydraulicly compressed concrete block. They call it Reconstructed Stone. You can make any size from 9 inches by 12 inches by 24 inches down.

And these can be made in the form of veneer slabs, concrete block or a special building shape that lends itself well for the construction of walls.

Any kind of surface imaginable can be secured. All that is necessary is to sprinkle some of the special aggregate desired on the face block, cover this with a facing concrete of the desired color, put in the backing concrete and compact the whole thing in the hydraulic press.

* * *

THEY were using some of the products of this machine to build a dandy golf club nearby. A special facing was used for the outside wall blocks that gave the wall life and color.

The same type of block, only with a limestone facing was used for the interior walls. Then the base course of the inside wall blocks was faced with jet black concrete.

The application of these block gave some idea of the possibilities of the use of concrete units for both interior and exterior walls.

* * *

A LITTLE experimenting often leads to worthwhile savings. At least that was the case with a concrete brick manufacturer who had started to wonder what would happen if he used different aggregates than the plant had always been using.

Near the plant was a sizeable gravel pit and a wealth of aggregates of varying sizes was available. He had always been using a 1 to 6 mixture of cement and sand. But adding pea gravel to his aggregate he was able to increase the number of brick made from one sack of cement from 155 to 195, and still get tests that were well above the requirements for his market.

* * *

THIS brick manufacturer is an aggressive merchandiser, too. He makes a special light colored concrete brick that has become very popular for facing. It was being placed in a big movie house at the time of our visit.

Also, he saw that there was a possibility of using his common brick for building sewers and manholes and catch basins in his city. He went after that business and the manhole and catch basin construction alone furnishes a market for nearly a million brick each year.

* * *

IN these modern days a reinforced concrete frame is likely to be found hiding under the skin of almost any type of building. Not very long ago we ran across a peculiar gabled framework of concrete waiting for its walls and roof. "What," said we to ourselves, "May this queer structure be intended to represent?" But a few months later we found out, for passing that way again we saw the finished building. It turned out to be the community house of a large church, done in Gothic style, and looking very much as though it had been built long before the days of reinforced concrete.

# Floors of Reinforced Concrete Joists with Concrete Block Filler

## A Report of Field Tests Made by Wm. H. Dechant & Sons on Two Types of Floor Slabs Composed of Reinforced Concrete Joists with Cinder Filler Block—Costs—Advantages—Uses of This Type of Floor

Attention of builders is centering on economical designs of concrete floors, not only for the larger buildings, but for residences and smaller business structures as well.

The following report of tests performed on two designs of concrete floors in which fillers of Straub cinder block were used will be of interest to all concrete block manufacturers. They suggest a new sales field which, up to the present, has been practically neglected.

The tests and the report were made by Wm. H. Dechant & Sons, civil engineers, of Reading, Pa., for the Berks Building Block Company, also of Reading. The report is published with the permission of Wm. H. Dechant & Sons and the Berks Building Block Company.

### Design

*SLAB NUMBER ONE* consisted of T-beam joists on 21-inch centers, each joist being 5 inches wide and the total depth of floor slab, including the 2-inch T-beam slab, being 10 inches. This was designed by the use of accepted formulæ for T-beam reinforced concrete, to sustain a normal live loading of 70 lbs. per sq. ft. of floor with a safety factor of 400 per cent.

*Slab Number Two* consisted of plain 5 inches wide by 8 inches deep reinforced concrete joists on 21-inch centers. This slab was designed to sustain the normal household and office building live loading of 35 lbs. per sq. ft. of floor with a factor of safety of 150 per cent.

In both slabs the joists were spaced by means of Straub cinder blocks laid to form the proper joist and slab depth. The cinder blocks were laid carefully in line and butted together to prevent loss of concrete while casting.

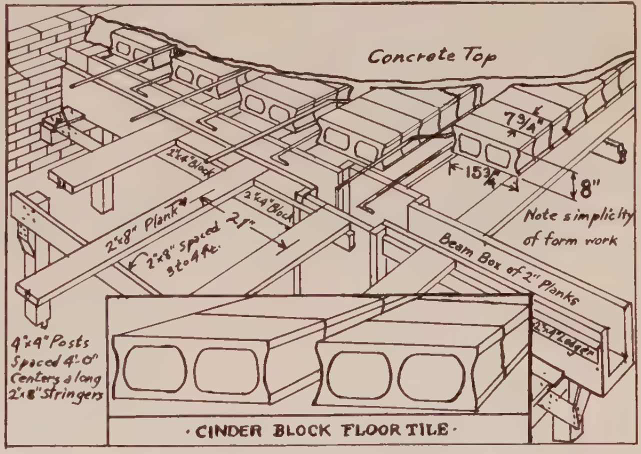
The principal base for the design of both of the slabs was that of simple continuous beams. No value was given to the bonding effect of concrete to the cinder block in the design. The percentage of steel was determined on the basis of 16,000 lbs. per sq. in. permissible stress in Slab No. 1 and 24,000 lbs. per sq. in. permissible stress in Slab No. 2. It will appear later in the results of the tests and calculations that as a matter of fact the bond between the concrete joists and the cinder block is considerable and greatly affects the strength of a floor slab of this type by causing a larger percentage of the sectional area of the slab to act compressively than merely the concrete itself.

We know of no existing formulae for the design of reinforced concrete and filler block floors which take account of this bond stress and its effect on the total strength of the slab. We were therefore confronted with the development of such formulae from test data which we obtained in the field.

In order to get comparative values between the action of a floor slab supported flatly on the walls of a building or foundation and the action as a simple beam only, the end support of one-half of Slabs No. 1 and 2 was supported on a roller to relieve the tilting action and consequent secondary stresses which are due to the wall support.

### Construction of Slabs

The slabs as designed were constructed at the plant of the Berks Building Block Co. in Northmont, Reading, Pa., under the direction of W. R. Heck, Asst. Engr. of our staff. All of the construction was done under ordinary field conditions and no special attempt was made to secure results other than those usually found in practice.



*The general construction of the floors tested*

Brick walls and bearing rollers were provided as called for in the design. The forms consisted merely of 2-inch x 8-inch x 16 feet plank laid flat and supported from below with studs. On these planks the cinder block were set. Then a form board to retain the edges of the concrete was placed around the entire slab.

Concrete, consisting of 1 part portland cement; 2 parts Jersey gravel; and 4 parts of crushed limestone, ¾-inch size and under excluding dust, was used in the joints and "T" beams.

In slab No. 1, two ¾-inch round corrugated reinforcing bars were placed in each joist, one being bent up at either support, along the shear line, and care was taken to keep the steel as nearly to its theoretical position as possible. The bars in all instances had hooked ends.

Before pouring the concrete for slab No. 1, wood sleepers were nailed directly to the cinder block, parallel to the joists and half way between them, thus helping to hold the blocks to line. Concrete was then poured into place and the joists filled to the top of the sleepers, giving a total depth of 10 inches just before testing, a 1-inch x 12-inch yellow pine floor was nailed to the sleepers.

Slab No. 2 was constructed similar to No. 1 with the following changes: —

Two ½-inch round corrugated reinforcing bars were placed in each joist. Concrete was poured to the top of the cinder block, only giving a depth of 8 inches for the slab. The wood sleepers were nailed to the block and the floor applied just before testing.

### TABLE I

CONCRETE JOIST AND STRAUB CINDER BLOCK FILLER SLABS
SAFE SUPERIMPOSED LOADS IN POUNDS PER SQ. FT. OF FLOOR

| Span | T-Beam Joists | | | | | | | | | | | | | | | Simple Beam Joists | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8+2 | | | 8+2 | | | 8+3 | | | 8+4 | | | 12+3 | | | 8+0 | | |
| | 2-¾" φ | | | 1-¾" φ-1-⅞" φ | | | 1 ⅞" φ-1-⅞" □ | | | 1-1" φ-1-1" □ | | | 2-1" φ | | | 2-½" φ | | |
| | $wl/8$ | $wl/10$ | $wl/12$ | $wl/8$ | $wl/10$ | $wl/12$ | $wl/8$ | $wl/10$ | $wl/12$ | $wl/8$ | $wl/10$ | $wl/12$ | $wl/8$ | $wl/10$ | $wl/12$ | $wl/8$ | $wl/10$ | $wl/12$ |
| 8 | | | | | | | | | | | | | | | | 214 | 281 | 347 |
| 9 | | | | | | | | | | | | | | | | 153 | 204 | 256 |
| 10 | 304 | 399 | 454 | 373 | 486 | | | | | | | | | | | 123 | 167 | 211 |
| 11 | 238 | 310 | 396 | 296 | 388 | | | | | | | | | | | 98 | 135 | 173 |
| 12 | 188 | 254 | 322 | 225 | 313 | | 359 | | | | | | | | | 74 | 105 | 137 |
| 13 | 148 | 204 | 261 | 189 | 255 | 322 | 292 | 387 | | | | | | | | 55 | 82 | 108 |
| 14 | 117 | 166 | 214 | 153 | 210 | 268 | 240 | 322 | | | | | | | | 40 | 63 | 86 |
| 15 | 92 | 135 | 177 | 123 | 173 | 223 | 197 | 269 | 340 | 294 | 393 | | 377 | | | 28 | 48 | 68 |
| 16 | 71 | 109 | 146 | 98 | 142 | 186 | 163 | 226 | 290 | 245 | 332 | | 317 | | | 18 | 35 | 53 |
| 17 | 54 | 88 | 120 | 79 | 118 | 158 | 134 | 180 | 246 | 206 | 285 | 361 | 267 | 363 | | | 25 | 41 |
| 18 | 40 | 70 | 99 | 61 | 96 | 130 | 109 | 159 | 209 | 173 | 242 | 311 | 226 | 312 | | | 17 | 30 |
| 19 | 23 | 48 | 74 | 47 | 78 | 109 | 83 | 126 | 170 | 145 | 207 | 269 | 190 | 268 | 345 | | | 22 |
| 20 | | 41 | 64 | 35 | 63 | 89 | 72 | 112 | 153 | 120 | 176 | 231 | 160 | 230 | 300 | | | 16 |
| 21 | | | | 24 | 49 | 75 | 56 | 92 | 129 | 99 | 149 | 200 | 134 | 197 | 261 | | | |
| 22 | | | | | 36 | 62 | 44 | 77 | 111 | 81 | 127 | 173 | 112 | 170 | 228 | | | |
| 23 | | | | | 28 | 49 | 32 | 62 | 93 | 66 | 108 | 150 | 91 | 144 | 196 | | | |
| 24 | | | | | | 39 | | 49 | 77 | 52 | 91 | 129 | 76 | 125 | 174 | | | |
| 25 | | | | | | 28 | | 44 | 71 | 40 | 76 | 111 | 60 | 105 | 150 | | | |
| 26 | | | | | | | | | | 29 | 62 | 95 | 46 | 88 | 129 | | | |
| 27 | | | | | | | | | | | 50 | 80 | 34 | 72 | 111 | | | |
| 28 | | | | | | | | | | | 40 | 68 | | 59 | 94 | | | |
| 29 | | | | | | | | | | | 30 | 56 | | 46 | 80 | | | |
| 30 | | | | | | | | | | | | 45 | | 34 | 67 | | | |

FOR LOADS ABOVE HORIZ. LINES, SHEAR REINFORCEMENT IS REQUIRED

In both slabs the cinder block were laid just to the edge of the span, the portion over the walls being entirely of concrete.

For the construction of slab No. 1, it required 250 Straub cinder blocks of the standard 8-inch wall type, 25 bags of portland cement, 2.7 tons Jersey gravel, 4.6 tons crushed limestone, and 550 pound of reinforcing steel.

### TABLE II

Quantities of materials in cinder block on concrete joist floor slabs.

| Concrete Top | Joists | 8" | 12" |
|---|---|---|---|
| | Depth of Tile | 8" | 12" |
| | Width | 5" | 5" |
| | Spacing center to center | 21" | 21" |
| 0 | Wt. of concrete & tile per sq. ft. of floor area | 53* | |
| | Cu. Ft. of concrete " " " " " " | 0.16 | |
| | Sq. ft. of floor area for 1 yd. of concrete | 170 | |
| 2" | Wt. of concrete & tile per sq. ft. of floor area | 78* | |
| | Cu. ft. of concrete " " " " " " | 0.32 | |
| | Sq. ft. of floor area for 1 yd. of Concrete | 83 | |
| 3" | Wt. of concrete & tile per sq. ft. of floor area | 90* | 120* |
| | Cu. ft. of concrete " " " " " " | 0.41 | 0.49 |
| | Sq. ft. of floor area for 1 yd of concrete | 66 | 55 |
| 4" | Wt. of concrete & tile per sq. ft. of floor area | 103* | |
| | Cu. ft. of concrete " " " " " " | 0.49 | |
| | Sq. ft. of floor area for 1 yd of concrete | 55 | |

For construction of slab No. 2 it required 250 Straub cinder blocks of the standard 8-inch wall type, 14 bags of portland cement, 1.7 tons Jersey gravel, 2.8 tons crushed limestone and 250 pounds reinforcing steel.

For a period of 3 weeks after pouring, the slabs were kept covered with about 1½ inches of sand which was kept wet for the first 10 days. The atmospheric temperature was recorded 3 times daily for the first 10 day period, averaging 68 degrees Fahrenheit. At the end of the 3 week period all curing sand was removed.

The slabs as constructed were tested to rupture under the direction of our staff.

The calculated loads were applied by spreading sand over each slab, to a uniform depth. The sand used was first tested for weight per cubic foot. Pig iron was then used to add additional loadings up to the point of rupture of each slab. Prior to loading and after the addition of each increment of loading, deflection measurements were taken at two points on each slab. Extension of the reinforcing steel was measured with Berry strain gage on two joists of each slab.

The results of the test loadings and deflections of the slabs tested are shown in the accompanying graphs (plates I and II). The measured deflections are tabulated on the face of each graph as well as the final set after removal of the loading.

By reference to the graphs it will be noted that the deflection under the calculated loading is practically identical for all slabs, and that the slabs will wall bearings at each end show greater stiffness to superimposed loads than do the slabs with one end supported on a roller, as is indicated by the slope of the lines of the graphs. The line having the least slope represents the stiffest slab.

A great deal of computation has been made to determine the relation between the theoretical formulae for the moment arms of resistance coupe of each slab and the actual resisting moment which the slabs developed on test. In these calculations no value is given to the compressive strength of the wooden floor nailed to the sills on the slab but it is admitted that this floor does have some effect of strengthening the whole slab against deflection.

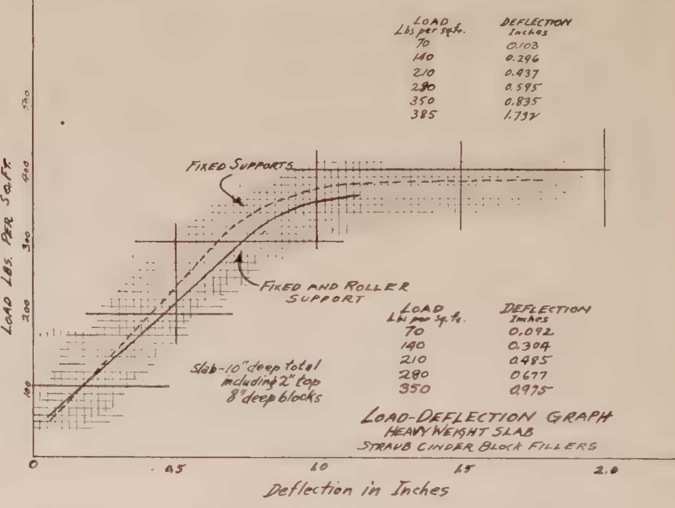


*Plate I*

From our calculations, we have determined these facts:—

1. That the neutral axis of slabs of this type made with cinder blocks is at a lower point in the section of the beam than is represented by the standard flexure formula, due in our opinion, to the additional compressive area which is brought into action through the bonding of the cinder blocks and the concrete joists.

2. That the flexure formula properly applicable to this type of construction can be made to take into account this difference in the position of the neutral axis by the adjustment of the ratio of the moduli of elasticity of the steel and the concrete.

3. From our calculations with the adjustments made in the formulae mentioned under paragraph 2 we find that

*W. H. Dechant, testing engineer, recording deflections of slab loaded to 70 lbs. per sq. ft. with sand*

the calculated deflections compare with the actual measured deflections as follows:

| | Deflection | | Lb. per sq. ft. |
|---|---|---|---|
| | Measured | Calculated | Load |
| Slab No. 1—Fixed & Roller Support | .092 | .0755 | 70 |
| Slab No. 2—Fixed & Roller Support | .209 | .157 | 35 |

We consider these agreements as close as it is possible to obtain them without having a test slab mounted freely at both ends such as would be done in the laboratory, but which was impractical in field tests.

## Data

Based upon the tests of these floor slabs we have computed the safe superimposed loadings for floor slabs composed of cinder block fillers and T-beam joists in one case and plain joists in the other case.

The results of these computations for different bending moments are shown on Plates III-IV-V, in graphic form and in Table I in numerical form.

*Close-up view of floor slab device for recording deflections*

As a matter of interest to builders, the quantities of material required for each square foot of floor are given in Table II for various types of floors.

Plate VI shows an isometric drawing of the construction methods which can be used in the erection of cinder block and concrete joist floor slabs.

The cost of floors of this design is governed largely by the simplicity of construction methods necessary for their erection and the cost of the filler block material. Expressed in percentages, the cost per sq. ft. of floor of cinder block filler slabs designed for 70 lb. (heavy duty) live loading such as garages, warehouses, etc. is represented thus:

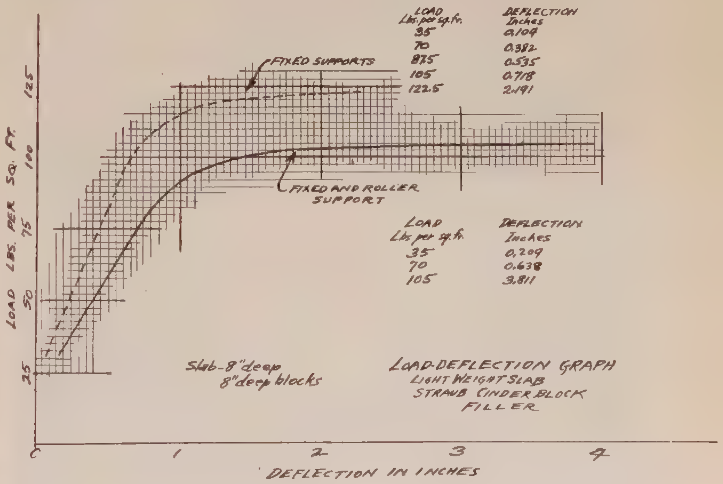


*Plate II*

| | Per Cent |
|---|---|
| Forms (first cost usable over and over again) | 20 |
| Concrete and steel | 48 |
| Filler blocks (Straub cinder blocks) | 32 |
| | 100 |

For light duty slabs such as for residences, hospital rooms, office buildings, apartments the cost is represented thus:

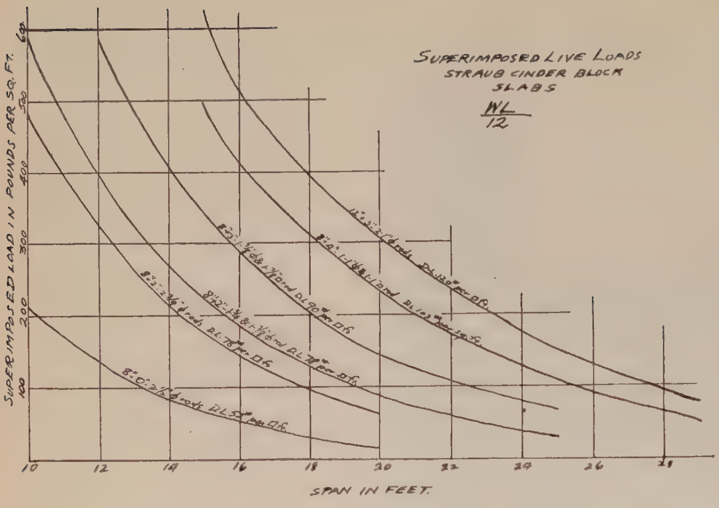


Plate III

| | Per Cent |
|---|---|
| Forms (first cost, usable over and over again) | 25 |
| Concrete and steel | 31 |
| Filler blocks (Straub cinder blocks) | 44 |
| | 100 |

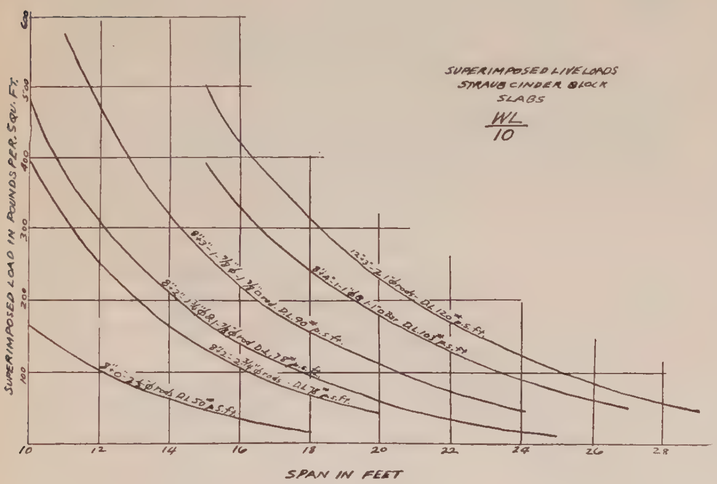


Plate IV

## Conclusion

It is our opinion that the type of floor constructed with reinforced concrete joists and cinder block filler is an economical and excellent form of construction for all ordinary purposes of building construction.

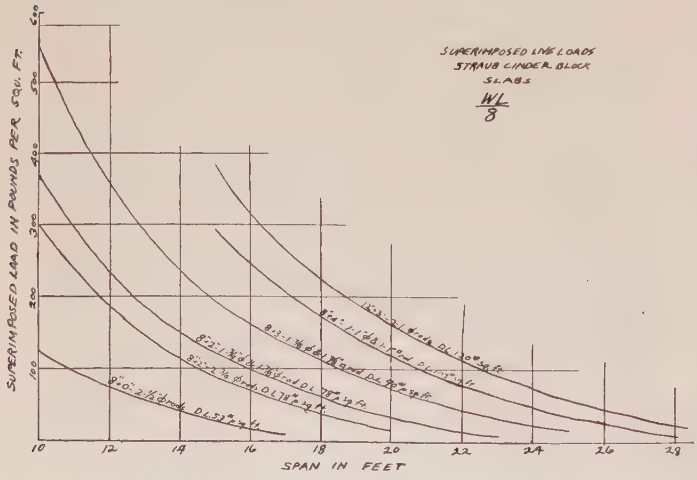


Plate V

First, because of their simplicity and relatively low cost.

Second, because of the fact that they are fireproof and soundproof.

Third, because they need no treatment before plaster can be applied to the underside of the slab.

Fourth, because they are elastic and can be relied on not to sag since the blocks are securely keyed to each joist.

Fifth, because they are adaptable to practically any form of floor construction without serious change of plan.

## Effect of Water Cement Ratio Studied by Government

Tests partially completed at the Bureau of Standards on the effect of water-cement ratio are of interest.

Three cements designated by the letters A, B and C ground to the same fineness in the same mill were made into concrete specimens, the same aggregate being used for all three concretes. The usual 1:2:4 by volume mix, Potomac River sand and gravel, the gravel carefully screened and recombined to give 10 different gradations of coarse aggregate, were used. One kind of sand was used in all cases. The grading of the coarse aggregate varied from a good gradation to poor. The poorest gradation of aggregates had the appearance of being worse than the fineness modulus figures of 5.2 indicated.

Sufficient water was added to the concrete to give approximately a measure of 95 per cent on the flow table. The slump varied from 5 to 6 inches. Concrete A made from cement A required slightly more water than B or C made from cements B and C, respectively.

Below are given the averages of the triplicate test specimens for the various ages and gradations. In these tables the strengths are expressed in percentages of strength of the A concrete. It is obvious that the one concrete A is of higher strength than either B or C. It is questionable whether any difference in strength exists in either B or C.

STRENGTH OF B AND C CONCRETE OF DIFFERENT GRADATIONS

| Age in days | 1 | | 3 | | 7 | | 28 | |
|---|---|---|---|---|---|---|---|---|
| Designation of concrete | B | C | B | C | B | C | B | C |
| Strength of various gradations of B and C concretes expressed as percentages of A concrete. A = 100 per cent in all cases. | 70 | 76 | 61 | 67 | 65 | 62 | 84 | 74 |
| | 77 | 77 | 66 | 72 | 68 | 64 | 85 | 80 |
| | 87 | 86 | 70 | 72 | 70 | 68 | 83 | 81 |
| | 68 | 63 | 76 | 80 | 79 | 75 | 103 | 80 |
| | 88 | 105 | 70 | 72 | 98 | 68 | 83 | 77 |
| | 78 | 92 | 78 | 71 | 76 | 72 | 93 | 84 |
| | 96 | 105 | 68 | 69 | 74 | 67 | 90 | 82 |
| | 78 | 85 | 70 | 70 | 70 | 70 | 86 | 80 |
| | 77 | 85 | 63 | 59 | 70 | 62 | 87 | 73 |
| | 80 | 83 | 70 | 71 | 71 | 68 | 86 | 77 |
| Mean value of strength in per cent of A | 80 | 86 | 69 | 70 | 74 | 68 | 88 | 79 |
| Strength of A in lbs./in.$^2$ | 180 | | 910 | | 1,370 | | 2,700 | |

There is an indication that the B concrete is approaching the strength of the A concrete with increase in age. Concrete C gives a possible indication of an approach to the strength of A also, but not so markedly as B.

Without detracting from the pronounced change in strength resulting from the change of water cement ratio for a given cement and aggregate, the tests just quoted illustrate the fact that for a given aggregate any prediction or estimate of the strength of the concrete must take into consideration the difference in the cement itself, differences which in some cases may be considerable.

# A Pipe Plant and a Block Plant Combined

## How the Midwest Concrete Pipe Company Makes Concrete Pipe, Block, Manhole Block, and Other Products in Its New Franklin Park, Ill., Plant—Two Plants, One for Pipe and One for Other Products, Work Together—Wa-Cement Ratio and Fineness Modulus Control the Mix

PART II

### Testing the Pipe

Just outside the south door of the plant the management has installed a special testing machine for testing their product. This is a Tuerck-MacKenzie machine that utilizes two points of bearing at the bottom and one at the top of the pipe under test. A loadometer is inserted between the moving head of the machine and the bearing point, and reads the load direct. This machine has revealed that the dry-mix pipe made on the Bullen machines is fifty per cent stronger than a number of samples of wet-mix pipe that have been secured for a comparative test. The American Concrete Institute requirements say that a 12-inch pipe, thirty days old, must reach a strength of 1245 pounds. The pipe made at this plant have gone as high as 1820 pounds, and normally exceed the above requirements anywhere from 10 to 40 per cent, as revealed by the testing machine at the plant.

Steam for the curing rooms is provided by a Brownell return flue 60 hp. boiler, working at a pressure of 25 pounds. The management intends to install an oil burner under this boiler, although it is possible that coal will be used during the first season.

The machines used in this plant utilize the services of three men; a mixer man, a machine operator, and an off bearer. In an eight-hour day such a crew can produce 500 lineal feet of 12-inch pipe; or from 100 to 300 lineal feet of 24-inch pipe.

### Proportioning Methods

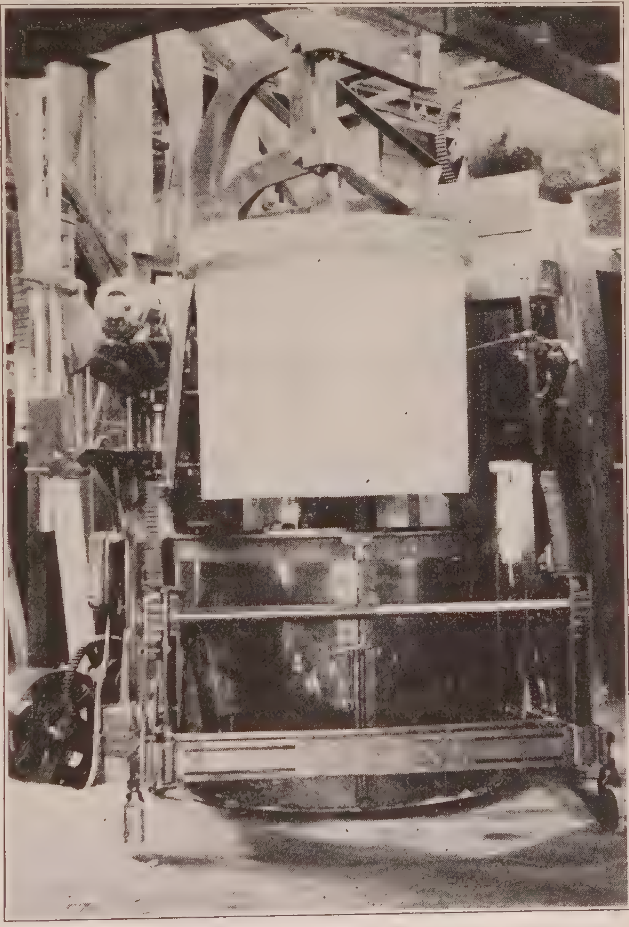
As already mentioned, the quality of the product of the plant is controlled by means of the application of modern scientific principles. Aggregates are graded to the required fineness modulus, and a definite water-cement ratio is maintained for the sake of uniformity. To aid in this control, the management has installed a small laboratory in one corner of the plant, and this laboratory is equipped to make sieve analyses of the aggregates, moisture determinations, and the testing machine in the yard is used to check up on the results of the control. A small but complete technical library is installed in this laboratory in order that everyone may keep abreast with the improvements in the art of making good concrete. A 1:3 mix is maintained, with a combined aggregate whose fineness modulus must average 4, and 3 gallons of water are used for each sack of cement.

It is the intention of the management to operate this plant, and the block plant, all winter. To make this possible, the storage piles of material and the bunkers are equipped with steam lines from the boiler, and hot aggregates and hot water will make winter production as reliable as summer production.

### The Block Plant

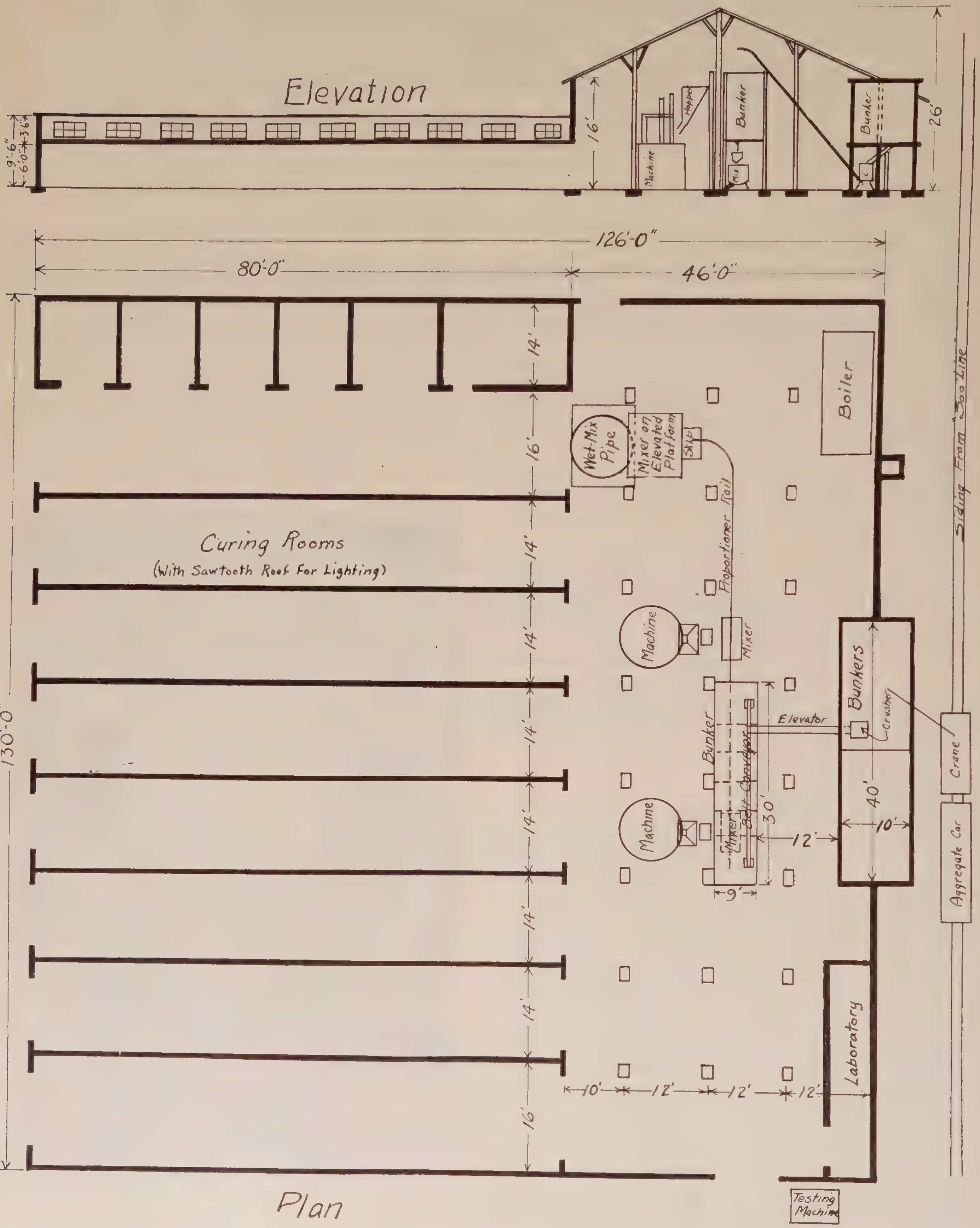
The block plant, for a capacity of 6,000 units a day, has a very simple arrangement, yet it contains a number of features that are not yet ordinarily seen in a journey of inspection through the industry. Not yet seen, because the idea appears so practical and so efficient that it is quite possible that other block producers will be bound to try it out for themselves in the course of the normal development of production methods.

This block plant is located just to the north of the pipe plant, and is separated from it only by a depressed railroad track that leads to the I. H. B. line on the west of the property. The track is depressed sufficiently so that the floor of a standard car will be on the level of the



*Now the core is stripped from the newly made pipe, the cart is in place, and mold and pipe will be taken to the kiln* working floor of the plant. This enables products to be loaded directly from the kiln or the yard by means of portable roller conveyors and the material shipped to the purchaser's team track without further handling.

At the east end of the block plant, extending the entire width of the building, is an elevated aggregate bunker to hold both torpedo sand and $1\frac{1}{2}$-inch gravel. This bunker is fed by the same crane and clamshell that serves the bunkers of the pipe plant, and the aggregates are supplied direct from the cars or from the stock pile. The stock pile



*Plan of the block plant, showing equipment for handling raw material, the block machines, belt and roller conveyors, the kilns, and the loading track* takes care of the winter needs of the block plant as well as the pipe plant. The bottom of the bunker is about five feet above grade, and the ground underneath the bunker is excavated about two feet to afford working room for the man who proportions the batches, and runs the mixer. Suspended from the bottom of the bunker is another of the proportioning devices like that used in the pipe plant. It receives the aggregates from the bunker and transports them to the Tuerck-MacKenzie mixer that is located directly beneath the proportioner track.

The mixed concrete is discharged from the mixer to the boot of the elevator that feeds the block machines. This drag-chain conveyor passes through a window in the east wall of the plant structure, and ends above the two machines and directly between them. A two-way chute leads the material directly into the supply hopper of each machine.

## Plant Layout

The block plant is laid out for maximum use of floor space. Reference to the layout drawing shows that most of the floor space is devoted to curing chambers. The two Anchor machines are located in the northeast corner. Cement is stored on the working floor to the east of the machines, and is passed back to the mixer as required. Running westward the length of the building, and serving both machines, is an eighty-foot belt conveyor, electrically operated, that runs on a rigid support of hardwood flooring. The offbearer places the units on this moving belt as fast as they are made, and the units travel along the belt until they are opposite the kiln to be loaded. Here they are picked up from the belt and are loaded into the kiln. As soon as the kiln is loaded the doors are closed and the steam is turned on.

The loading end of the belt is so located with reference to the machines that the offbearer does not have to walk with the unit he is removing from the mold. He simply picks up the unit, swings around, and places it on the belt, and turns around to throw in another pallet. The belt moves at the rate of 25 feet a minute, the speed being stepped down by means of a speed reducer mounted between the driving motor and the drive pulley of the conveyor.

When the block or other units are fully cured in the steam room they are removed from the kiln to the yard by means of portable roller conveyors that pass from the kilns to the yard through small windows in the wall of the plant. Units may also be taken from the kiln and loaded directly into railroad cars by the same means, since the depressed track allows spotting cars along the plant wall through which the kilns may be unloaded. Since the floor of the car is level with the floor of the kiln, it is quite easy to utilize roller conveyors for this purpose. Then, too, the several spurs from the I. H. B. line running into the yard make loading from stock pile to cars a matter that is easily accomplished. Truck delivery is taken care of in the same way, and this method of loading is said to operate at a reasonably low cost.

## Making Manhole Block

An interesting feature that is to be observed in this plant is that the two block machines are not entirely devoted to the production of ordinary building block. In fact, an important product that is turned out is closely tied up with the pipe end of the business. Manhole block, the special unit manufactured there, is coming into its own. It is but natural that the purchase of concrete pipe for sewer work would entail the purchase of some material to be used in the construction of manholes. Hitherto, ordinary clay brick has been widely used in the Middle West for this purpose, while many communities have gone into the installation of reinforced concrete manholes, cast in place. True logic, however, would point to the use of a precast concrete unit that could be utilized for the same purpose.

## Manhole Block Successful

The management of the Midwest Concrete Pipe Company saw the advantages of a concrete manhole block and the logic of selling such units in connection with their sales of concrete pipe. They also saw the possibilities of supplying, at the same time, a precast curbing for the top of the manhole, ready to receive the cast iron cover that is ordinarily used. Thus, these two units are manufactured in their plant, and the manhole block is now going out to a great many jobs. The engineers and the contractors have tried out the economy and the reliability of the products, and the plant is now almost swamped with orders.

## Manufacture Is Simple

The manhole block are made on the Anchor machines after but a simple change of mold and pallet. The cost of producing the units is low, and it interferes in no way with the production of standard load-bearing units for straight wall work. The management has found this a very attractive adjunct to their business and has had no trouble disposing of the units at an attractive price. In selling the units, they do not so much quote units at so much a thousand, but rather make a blanket bid on all pipe, manhole units, and manhole curb and catch-basin block needed for the specific job. Since they make a good strong product it is not necessary, in these bids, to figure on much extra material to cover rejections and breakage. Consequently it is easy to get the cream of the business on the basis of a reliable product of uniformly high strength, delivered at the right price in the required quantities at the right time. On subdivision contracts they are in an especially desirable position, since they cannot only supply all material for the pipe lines, but can also furnish block for foundations and other construction work at the same time. The growth of the business has fully justified their expectations.

## Chicago Office

The plant is under the management of Howard Schurmann, president; C. H. Bullen, vice-president and treasurer; Frank Novotny, secretary; and J. A. Dunn, chief engineer. A downtown office is maintained at 139 North Clark Street, Chicago, and from this office a part of the sales effort and promotion work is carried on. A small office is also maintained at the plant, where a part of the business is transacted. In that way it is possible to have two places from each of which some principal of the company may do his share in continuing to build up the business. It is interesting to know that the Mr. Bullen who is in charge of the production of the plant is also interested in ventures in the West, and is the inventor of the various devices utilized in the plant itself.

*Science, plus horse sense, plus good materials, plus the average good crew, is the most workable equation for obtaining good concrete. Read about it in coming issues.—The Editors.*

# With the Manufacturers

## INDUSTRIAL LITERATURE

### *Central Mixing Plants*

Much interesting matter is found in the 36-page book entitled *"Inundation and Central Mixing Plants,"* published by the *Blaw-Knox Company,* Pittsburgh, Pa.

Blueprints, diagrams and frequent photographs show plant layouts, the effect of moisture on sand, and the principle of inundation.

### *Floor Hardener Booklet*

A double treatment known as *"Hard-Wear,"* for concrete floors is described in a twenty-four-page booklet published by the *Slingluff Concrete Processing Company,* Baltimore, Maryland.

### *Super Cement*

*The Marquette Cement Manufacturing Company,* Chicago, Ill., and Memphis, Tenn., announces in a four-page folder the addition to its production of *High Test* portland cement, that of *Super Cement.*

### *Celite Folder*

A four-page folder *"Making the Most of Concrete With the Aid of Celite,"* has been received from the *Celite Products Company.* The folder shows a number of structures and pavements in the construction of which concrete containing Celite was used.

### *Water-Cement Ratio and Celite*

*Bulletin* 325-*B* published by the *Celite Products Company,* Los Angeles, gives information on the use of *Celite* in concrete, including a discussion of the use of *Celite* where the water-cement ratio is specified. Data on concrete construction and the effect of workability on the permeability and appearance of concrete, are included.

### *Correction*

In an item published in this column in the June issue, credit was given the Atlas Portland Cement Company for the publication of a bulletin under the signature of H. Eltinge Breed. The Alpha Portland Cement Company should have been credited instead.

### *Contractors' Equipment*

The application of *C. H. & E.* products, including hoists, saw rigs, mortar mixers, and pumps, is shown in a broadside published by *C. H. & E. Manufacturing Company,* Milwaukee, Wisconsin.

### *"Typical Elevators"*

The Link-Belt Company of Philadelphia, Chicago and Indianapolis have just issued a new publication entitled "Link-Belt Typical Elevators." The book consists of 44 pages of illustrations, examples, ratings, capacities and tables showing how to select typical elevators.

### *Unique Folder*

*The Sullivan Company* of Memphis, Tennessee, and Montreal, Canada, has published a group of leaflets covering the uses and specifications of its products under the title of *"Life Preservers for Buildings and Equipment."* The leaflets, each devoted to an individual product, are enclosed in a convenient file folder.

### *Conveying System*

One of the four-page folders issued by the *Cleveland Electric Tramrail Division* of the *Cleveland Crane and Engineering Company,* Cleveland, Ohio, deals with a truck hauling system by which trucks may be rolled onto platforms suspended from carriers.

### *"Plastint" Directions*

Directions for using *"Plastint,"* a colored finish plaster, and gaining a number of desirable textures, are contained in a 24-page booklet published by the *United States Gypsum Company,* Chicago.

### *Stuccoing System*

*The Holmes System of Pebble Dashing* is described in a sixteen-page booklet published by the *E. W. Holmes Pebble Dash Company,* Princeton, Illinois. Illustrations show some of the satisfactory work done by this method.

## NOTES FROM THE FIELD

### *Smith Distributor*

*The T. L. Smith Company,* Milwaukee, Wisconsin, has appointed the *Bublitz Machinery Co.,* 2139 Washington Street, Kansas City, Mo., as the distributors for *Smith* pavers in Kansas and western Missouri.

### *Enlarged Hoisting Handbook*

The Novo Engine Company, Lansing, Michigan, has revised its Hoisting Handbook to include some new tables, drawings, and other illustrations and text. The book contains forty-four pages and may be secured bound, or unbound for insertion in binders.

### *New Foos President*

At the recent Board of Directors meeting of the Foos Gas Engine Company, Springfield, Ohio, Mr. J. F. Baker was elected president, and Mr. M. E. Baker, secretary-treasurer.

A decision was also made to change the name of the company to "The Foos Engine Company."

### *Allen Accepts New Position*

Leslie H. Allen, for the past three years general manager of the Hawthorne Roofing Tile Company of Cicero, Illinois, and of the Concrete Tile Machinery Company of Cicero, has resigned these positions and accepted the appointment of president and general manager of the Hawthorne Roofing Tile Company of New York, 507 Fifth Avenue, New York City.

Prior to his connection with the Hawthorne company of Cicero, he was for three years assistant manager of the Cement Products Bureau of the Portland Cement Association, Chicago; and eleven years with the Aberthaw Construction Company of Boston, Mass.

### *Rex Chicago Office*

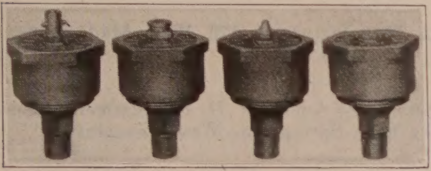
The Chicago office of the *Chain Belt Company,* Milwaukee, Wisconsin, manufacturers of *Rex* chains, transmissions, elevating, and conveying machinery, is now at Room 1515, 222 West Adams St., Chicago, Illinois.

# New Equipment

## Hex-Top Grease Cups Have Alemite Fittings

Of interest is the announcement of Link-Belt Company, Chicago, Indianapolis, and Philadelphia, which describes their new "Hex-Top" Malleable Iron Compression Grease Cup with Alemite, or Zerk fittings.

The trade name "Hex-Top" describes the shape of the grease cup head. Six-sided, it offers, for turning, an easy purchase for any type of wrench, and a good grip for the hand.



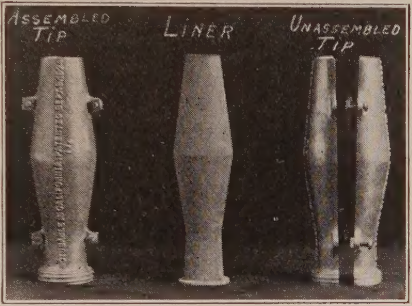
An example of its use would be in the lubricating system of a long belt conveyor using many grease cups for the idlers by filling all the cups at one time with a grease gun applied to the Alemite fitting, when the cap is turned up to a high point, but not entirely unscrewed or removed.

The filling can be done without waste of grease, and without any inconvenience; the cup holds a good reserve for use of the compression feature; and an occasional slight screwing down by hand or wrench is all that is necessary until it is time to have a general refilling of the cups.

If a bearing gets warm when the grease gun is not at hand, a turn or so of the cap takes care of the emergency.

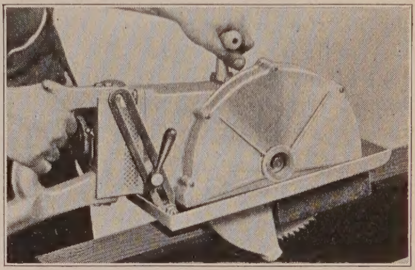
## "Cement-Gun" Has New Nozzle

The Cement-Gun Company, Inc., Allentown, Pennsylvania, reports that it is equipping all machines now with a new type of nozzle. A mixing chamber is provided, into which the cementitious material passes immediately after the injection of the water and where it is thoroughly mixed and hydrated before passing out. Machines now in the hands of users as well may be equipped with this newer and more efficient "Cement-Gun" nozzle.



## Perfected Saw Gives Added Visibility

Its telescoping safety guard, carrying shoe, and its visibility are items that make the Alta portable saw, a product of the Wappat Gear Works, Pittsburgh, Pennsylvania, desirable. Handles are placed so as to give perfect balance with minimum effort in handling. The wide shoe is adjustable, insures perfectly square cuts and trimming, cutting to any depth in flooring or concrete form panels.



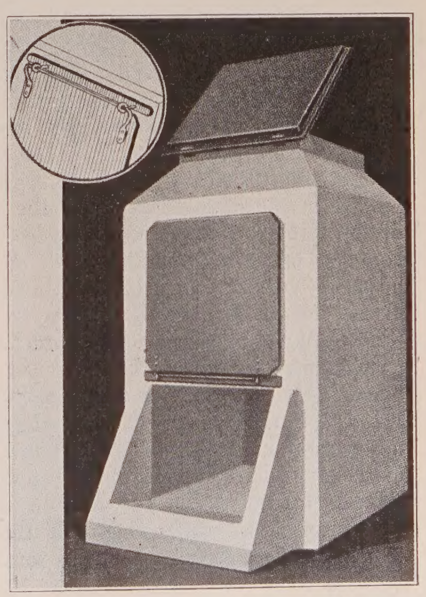
Further visibility is supplied by air pressure directed toward the front of the saw, to prevent the accumulation of sawdust.

## Molds for Well-Designed Rubbish Containers

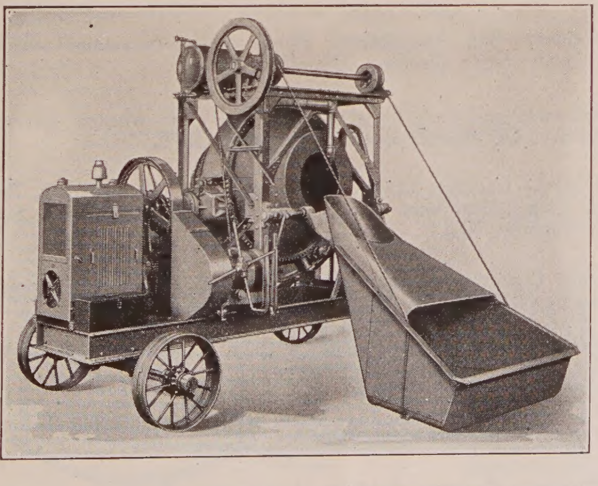
While concrete ash containers do cost a little more, they are finding much favor with householders. On one particular type the lower or collection door remains automatically closed and the floor at this door has an inward slope to prevent escape of liquids.

The container measures 42 inches in height, and 24 x 24 inches at the base, which is "drawn in" at the top to carry the galvanized metal cover.

Molds are furnished by the Sanitary Garbage Box Co., Chicago, Illinois.



## T. L. Smith Company's 10-S Mixer Compact



This is the compact, 10-S mixer designed by the T. L. Smith Company, Milwaukee. Wisconsin, for 1-2-4 concrete. It has a daily capacity of 100 to 150 cubic yards, and is equipped with a power loader and water tank.

# Mixer Musings

Reported by "Joe"—The Mixer Boss.

## *Bill Joins Up!*

*Dere Joe:*

SOMEBOB' tella me you hava de gooda union where de boys don't paya da dues but only getta da card! That suit me fine! You just senda da card and I belong.

De firsta time I makka da what you call slump test, me I'm inspect on a big job for big contractor and I no likka da wet soup the mix turn out. We filla da slump and tak him up just so and den we all move so the mud she no run over our shoe. Me, I'm stan' up and holler lika hell at them mixer and say that good way for to control de mud. We have um specs say "5 to 7 inches slump," but these first wan we no can measur, she all run away!

After this, I'm make many slump, and not so good all the time cause she different. I learn also punch mud in pipe for cylinders, ninty punch all cylinder, 12 cylinder all batch, dam hard work to do when soft hands and weak back, too. Cylinders not so good. Finally we persuade contract buy other sand, then we get cylinders too dam strong. Contract, he say dat good, we save cement wid dis odder sand. Me, I'm all pleas', job go nice, get strong roof! 'Nother building we build on same contract she fine, no mud too wet, no mud too dry, contract he please too.

We break on dis contract more 390 cylinders and fin' out much about mud and most depend on sand,—how she act, how she make mud wid less water than odder, how smooth she be for to trowel. Next year we havva annodder job, make good mud, good slump, but cylinder week likka da box afta de knockout. What you s'pose? Sand not so good. Change da sand, all O. K.

Well, Joe, me I neva see you on any my job, but you senda da card and I carry it so when you come see me I show it to you.

(Signed) *Bill.*

*Joe, The Mixer Boss:*

The undersigned humbly petitions membership in the Guild of Certified Slump Testers, who has been making them and busting them since 1906 and is sometimes known as the "Prohibition Agent." (I hasten to add this reference has no allusion to the Eighteenth Amendment.)

Back in the days of 1906 on the Detroit River Tunnel lots and lots of mixes were made in the old galvanized iron pan using a pointed trowel. Pour in the water, get the wrist working with the double reverse motion, drop it off the end of the trowel, and say to your partner, if any, "That looks good and sloppy; put her in the mold before it runs away."

My claim for membership in the Guild rests on the fact that I made slump tests in the fall of 1918, using a paper cylinder mold for the slump. The tests were made on the concrete going into the concrete barges made by Thomas Curry & Co. for use on the New York Barge Canal, under the supervision of the Concrete Shop Section of the Emergency Fleet Corporation.

(Signed) *A. W. Munsell.*

# *Organizations*

**American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit.**

**American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.**

**American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.**

**American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 West Thirty-ninth St., New York City.**

American Road Builders' Association; Wm. H. Connell, President, Miss E. A. Birchland, Secretary, 29 W. 39th St., New York City.

American Society for Testing Materials, C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; D. H. Sawyer Secretary, 1150 Munsey Bldg., Washington, D. C.

**Associated Metal Lath Manufacturers; 123 West Madison St., Chicago; Wharton Clay, Commissioner.**

Building Officials Conference of America: H. E. Plummer, President, Fred W. Lumis, City Hall, Springfield, Mass., Secretary.

**Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.**

Concrete Products Association; S. I. Crew, President, Norwood, Ohio; Austin Crabbs, Secretary, Box 343, Davenport, Iowa.

Iowa Concrete Products Association; Floyd Goodrich, President; R. L. Gavin, Secretary-Treasurer, 405 Hubbell Bldg., Des Moines, Iowa.

National Association of Building Trades Employers; A. E. Coleman, President; A. W. Dickson, Executive Secretary. 2226 Builders Building, Chicago, Illinois.

**National Association of Builders' Exchanges; William F. Chew, Baltimore, President; Earl F. Stokes, Secretary, 15 East Fayette St., Baltimore, Md.**

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

**National Housing Association; Lawrence Veiller, Secretary and Director, 105 East Twenty-second St., New York City.**

The National Lime Association: Burton A. Ford, Secretary, 927 15th Street, N. W., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 933 Leader-News Building, Cleveland, Ohio.

National Sand and Gravel Association, V. P. Ahearn, Executive Secretary, 432 Munsey Bldg., Washington, D. C.

Nebraska Concrete Products Association; A. V. Anderson, President, Reimers-Kaufman Co., Lincoln, Neb.; E. L. Bateman, Secretary, Bethany, Neb.

**Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.**

Portland Cement Association; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; A. P. Kuranz. Secretary-Treasurer, 425 E. Water St., Milwaukee.